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Contracting Practice

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A COMPLETE practical outline of practice from the time of preparation of an estmate on down through the actual construction and ending with the final analysis, is proposed in this article and others to follow.

There are books and books, but no where can one obtain a satisfactory outline of this subject so arranged that the contractor realizing the need of a more systematic organization or the young man, who desires to learn as quickly as possible in order to be of the most service, can find information so arranged and in such logical order covering the whole subject as to be of any value. A multitude of books and special articles are available giving some one man's idea of some one part of a contractor's work, such as "Office Systems," "Cost Keeping," "Field Management," etc., but this information, while possibly as good or better than average practice, can not be adopted, because all of these various ideas can not be thrown indiscriminately together as a basis of a working organization, and no one idea can be adopted without requiring a correlation of all other parts of the work. As such a procedure is considered too much of a task by the average man, he generally decides to let things drift along.

The writer has for a long time thought that in his own business if the system used was reduced to writing, so that each and every man employed, no matter in what capacity, could be referred to this standard practice, instead of having it verbally repeated time and time again, much good would result; first, in a closer harmony of relationship and a resulting greater output, and second, the larger opportunity and invitation for suggestions and improvement.

To Messrs. Taylor, Grant, Emerson, et. al., we are indebted for a systematic study of industrial organizations and a better management of shops with the idea of greater efficiency. Messrs. Gillette, Gilbreth, et. al., have carried the same ideas and same line of thought into the engineering and construction field, and yet in the opinion of this writer, neither "Costa Data," "Motion Study," or any of the numerous papers printed satisfy the general need of a comprehensive study of the whole subject of contracting, wherein a general scheme of practice from estimating to analysis is outlined.

The methods suggested in the articles to follow may not be the best, but they are offered as the result of a practical experience of several years, and should be of value, at least in forming the nucleus of any organization. Certain fundamental truths exist in all contract work and these facts can only be learned by experience. For this latter reason alone, if no other, this series of articles should be of value, especially to the young engineer and contractor.

There is no doubt of the present need and importance of systematic cost keeping, cost management and cost analysis in the majority of our existing industrial plants. If this is the case, how much more is the same procedure required in the contracting field, which covers the industrial line, only being complicated by the operations being confined. In other words, the contractor's work it truly industrial, but he is handicapped by the nature of the operations, inasmuch as he must work in the open, unprotected from the elements, must attempt to keep records of men and materials when same are shifting and difficult to locate; and in general, systematize an ignorant, carefree, low-grade force of laborers in such a manner as to secure adequate working results as well as obtain such data as will fix the special job as a permanent record of value as a profit-making proposition.

In construction work the whole field

must be considered, and this means that the same laborer may be moved from one class of work to another, even during the same day, and perhaps several shifts may be necessary. Along with these difficulties run the trials with union labor, with all its exacting stipulations as to rates of pay, hours of work, etc. It is all very well to talk or write regarding what can be done if all these obstacles are removed, but in ordinary work, the kinds of jobs we all experience, these things are not removed, and, as a result, ordinary circumstances and conditions must apply, and any system adopted must recognize same and adjust itself accordingly.

It is all right and proper to talk of "staff" vs. "line" and to encourage the civil instead of the military type of organization, but after all in ordinary construction work the laborer must be driven by an expert supervision and the results lie with the commander rather than the individual workman, and this is so because of the character of the labor available.

Under these conditions, all that can be expected is a fairly accurate checking of labor employed, and such cost data are not absolute in fact, but simply characteristic of the kind of work, and sufficiently close for all practical purposes and for guidance in analysis of like work. For these reasons, cost data, so styled, are of no value as they assume to be and report facts or truths, but they are of more or less influence, depending upon the elaborateness of the published data.

Contracting never can be an exact science or subject to exact rules, all writings as to principles to the contrary, notwithstanding. There are no five, ten or twenty principles involved. Contracting, like engineering, or even more so, is a matter of common sense or good judgment, but an understanding may be developed and mental analysis encouraged by a proper use of methods, standard forms, printed records and analysis. In other words, while preaching modern methods, requiring all that has been written as to office and field systems, and while advocating some such system as will be outlined hereafter, still the writer desires to be understood as emphasizing the fact that all goes to the mental discipline or building up of mental caliber and that, so far as records go, they are of questionable value. The engineer and contractor who will work and work the hardest to obtain system and records, does not profit so much by the actual records as he does by the development within his own brain cells. Do not overlook this point. Records are valuable only in their effect on the judgment which indicates that the treatment of a new proposition is the result of experience. Experiences may be fortified by a proper system of dividing, itemizing and recording costs of labor and materials. The series of articles proposed will be strictly in line with the foregoing ideas.

In the first place, three general divisions of contracting work are recognized, viz.: Estimating the job, construction of the job, and a final analysis and recording of costs. An attempt will be made to carry these three divisions through each monthly issue. Each one of these divisions carries with it sub-divisions which are directly related to like questions which exist all through the job, and therefore each issue will cover a certain sub-head, which will be given the prominence of title and then sub-divided as to its importance under the three main heads noted above. By such an arrangement, the estimating engineer or office force, the field engineer or the contractor, and the analysis man will find in each issue such matter as will, we hope, be of benefit, but above all, such statements along each line as will promote discussion and correspondence.

A further division will be made in these principles by sub-dividing under each heading into "material," "labor" and "general field charges." Running parallel with this idea a proper division will be made with consideration for the bookkeeping or clerical, engineering or planning and the field or executing departments.

The outline of this series of articles is a large one and the task set for ourselves is no small one, as is evidenced by the subject matter next following. As the series will require all of a year and possibly more for a complete handling, our readers are invited to contribute freely to the discussion month by month, and it is felt that such a forum as this will establish will be no small part of the value of this department.

1. *Estimating the job on a basis of a definite, well-considered plan, with reference to execution and definiteness in final analysis of results.*

Examinations of specifications for unusual clauses and abstract. Comparison of plans and specifications. Special note of peculiar features.

Proper method of taking off quantities, including checking; estimating

blanks; lay out of work and method of operation; division of work; short cuts; approximations for check; when quantities important and when unit prices; labor and material separate; general charge methods; how general charges are affected by character of work; equipment required and how charged out; notes and sketches showing basis of estimate; filing of esti mates for reference; value of estimates regardless of execution; "dope" book.

2. *Executing the job, following as as closely as possible the estimated plan of operation and, where defective, requiring modification and change, revising or extending estimate to cover same.*

Equipment; organization and forces; timekeepers and field forces; progress plans and field engineer; forms for cost and quantity reports; division of work by sections; simplicity of items, but essentials separated; direct and indirect labor and materials; field approximations or units for reports; general office system of purchasing, distribution of cost of material and labor and making monthly estimates; better supervision by use of daily reports; instructions to (*a*) foremen, (*b*) timekeepers and clerks, (*c*) engineers and firemen, (*d*) mechanics, (*e*) yardmen, (*f*) general office, (*g*) weekly cabinet meetings.

3. *Analysis of job. Running entire job as far as possible according to estimate, but with due allowance for actual reports based on conditions as formed during execution.*

Cost and quantities and unit costs to date; rate of progress; revision of estimates from time to time; discovering of weak points; daily knowledge of work; time of completion; comparisons of sections, men and equipment; comparison with other jobs of like character; separation of ordinary from unusual units; tabulation of results; graphical chart results; results not absolute but mental discipline; danger of copying data; reducing to a fixed rate of pay; cost of materials f. o. b. job and not purchase price; danger of stop-watch methods; padded pay rolls.

Sewage Disposal With Respect to Offensive Odors*

By George W. Fuller, M. Am. Soc. C. E., New York City

Oxidation of Sewage Impurities

SEWAGE may be defined as the spent water supply of a community, together with those household and industrial wastes which are removed from their point of origin by water carriage in underground pipes.

For several generations it has been the custom in various localities to discharge sewage in the cheapest and most convenient way into the nearest available water course. During the past twenty-five years much progress has been made in the art of sewage disposal so as to guard against objectionable putrefactive odors in streams that are too small to receive untreated sewage. In some measure this progress relates to the disposal of sewage by dilution in fairly large streams; but it refers more particularly to advances made in the disposal of of sewage in works of artificial construction in which use is made of sedimentation, filtration and other methods.

Sanitarians are agreed that the proper disposal of sewage is of importance both as to prevention of putrefactive odors in streams and also as to the elimination of disease germs from some water courses which are related to either drinking-water supplies or shellfish layings. Developments in the field of sewage disposal have been accompanied by a peculiarly wide range in the opinion with which the plants are regarded by persons living in their general neighborhood. The opposition of various land owners around some plants is so marked that it is indeed stated that the sewage-disposal plants are themselves a nuisance, even in sparsely populated areas.

It is scarcely possible to install sewage-disposal plants to serve large towns and cities without there being some

*Presented before the Congress of Technology at the Fiftieth Anniversary of the Granting of the Charter of the Massachusetts Institute of Technology.

noticeable odors and smells immediately at the plant. These odors, however, at some plants are not and indeed if the works are properly built and operated should not be offensive. Even at the works themselves the odors never should be as noticeable as the odors emanating from some fertilized lawns or industrial establishments.

On the other hand, it is unfortunately true that some sewage-disposal plants have been illy arranged as regards location and design, and that some of them have been poorly operated. The result has been that in some places objectionable odors undoubtedly have arisen and in consequence the offensive smells from such plants have been used with much force as arguments by land owners, who, for sentimental reasons, protest vigorously against disposal works being built within several miles of properties in which they are interested.

Many anomalous conditions of a complicated nature have arisen recently in America with respect to sewage-disposal projects. In nearby communities litigations and legislation have been directed to diametrically opposed propositions. Thus the contests are instituted in some instances to compel, and in other cases to prevent, the installation of disposal works; while elsewhere they relate to efforts to remove plants from the outskirts of a town or the converse; that is, to preventing an isolated site being adopted if it happens to be near some land owner of especial influence.

The question of offensive odors is but one feature, but it has been a bothersome one in some instances where persons have persistently exaggerated the shortcomings of some plants and converted the exceptions into the rule as regards sewage-disposal experiences.

Regardless of the unreasonableness and selfishness with which the opponents to sewage-disposal sites in their neighborhood may present their cases in some instances, it seems to be clear that those having to do with sewage-disposal works must increase their efforts towards building plants free of nuisance as to offensive odor when operated properly, and furthermore to see to it that plants are operated in such a manner that there is no just ground for complaint from residents in the neighborhood of such works which at best are open to sentimental prejudices.

The importance of disposing of sewage in a sanitary manner is so great in the interests of the public health that it is scarcely necessary for the writer to dwell further upon this introduction before proceeding to outline some of the principal features of our present understanding as to the processes by which sewage may be disposed of in a satisfactory manner, and the means by which such process may be utilized to best advantage.

COMPOSITION AND DECOMPOSITION OF SEWAGE.

As the nature and origin of sewage implies, it is a product that varies tremendously in its compositions. In a rough way it is about 99 to 99.5 per cent. pure water, but the fraction of 1 per cent. of impurities varies within very wide limits at different hours of the day and as between the sewage of different communities, due to the influence of the habits of the people, and also to the amount of industrial wastes, street wash, etc., that enter the sewers.

In a paper presented in 1903 by the writer to the Boston Society of Arts, these various features as to composition were detailed at much length. Here it may be said that it is the organic matter, widely varying in quantity and quality, which is of principal interest to those engaged in the field of sewage disposal. Some measures as to the quantity of the organic matter were applied with considerable accuracy years ago by those interested in ascertaining the fertilizing properties of sewage. As that aspect of the case did not yield practical results on a commercial basis, the sewage chemists of different countries have been content to follow the practice of using a series of arbitrary methods which give widely divergent results. The results have value, however, for comparative purposes if applied to samples which have been collected in a manner to make them representative of the sewage before and after treatment.

Recently knowledge as to the composition of sewage in more practical terms has received some impetus by studying the putrescibility of sewage and sewage effluents through bacterial agencies and in securing a measure of the amount of oxygen required for bacteria to oxidize the more unstable portions of the organic matter in sewage.

Such methods were suggested by the Royal Commission on Sewage Disposal, and have been applied at some places in this country. For instance, Mr. Clarence B. Hoover, Chemist in charge of the Columbus sewage-dis-

posal works, has recently employed this method of measuring the strength of the local sewage, beginning in March, 1910.

To appreciate the composition of sewage from the standpoint of the prevention of odors, it is necessary to bear in mind that the organic matter of sewage comprises both living and dead matter. The living matter will thrive so long as the food conditions and other environments are favorable thereto. The dead organic matter, in the language of the chemist, is subject to reduction and oxidation according to the conditions surrounding it. In fact, the organic matter of sewage is made up of such complex molecules that it has a well-defined tendency to decompose; that is to say, to separate into molecules of simpler form.

Organic matter, as a general proposition, if resolved into simpler and more stable compounds through oxidizing agencies, will produce no offensive odors that are noticeable. On the other hand, if sewage decomposes in the absence of oxygen, the well-known reduction processes spoken of as "putrefaction" will set in with their attendant malodorous by-products.

The measure of success, therefore, attending the operation of sewage-disposal plants, relates essentially to guarding against the putrefaction of sewage. This means that there should be obtained not only a stable, non-putrescent effluent, but also that the steps in the process of sewage treatment should be free of putrefaction or, if putrefaction is used for especial purposes, it should be under such circumstances that the surrounding atmosphere will be substantially free of objectionable decomposition odors.

Quite recently the question of nonputrescibility and stability has been carefully discussed by Prof. Earle B. Phelps in one of the U. S. Geol. Survey papers, and some years before that time the scope of the problems was outlined by the writer in the paper before the Boston Society of Arts, above mentioned, and from which the two following paragraphs are taken:

"The limitation in the amount of sewage which may be discharged into a water course without putrefaction setting in depends upon the oxygen-consuming properties of the sewage measured against the oxygen in the water of the stream, after making due allowance for the consumption of oxygen by the constituents of the water and by the matters contained on the bottom and sides of the stream."

"In studying exhaustively the technical and biological changes which take place in polluted waters, and the conditions under which putrefaction may be avoided, it is believed that the relative significance should be studied of the 'absolute oxygen-consuming powers' of the organic matter in sewage or effluent expressed in terms which can be readily appreciated; of the oxygen dissolved in the sewage of effluent, together with that which may be yielded by nitrates, sulphates, and other constituents of the liquid; of the oxygen similarly contained in the water into which the sewage or effluent is discharged; of the oxygen which may be received in the water by means of aeration and from higher forms of vegetable life; and of the absolute oxygen-consuming powers of the organic matter in the water of the stream and in the sediment on the bottom and sides of the stream itself. To these factors should be added the effect of the very important items of temperature and the period of time during which biological changes may take place."

By "absolute oxygen-consumed," in the above quotation, it was the intention of the writer to refer to the amount of oxygen under conditions of nature which would be actually consumed by bacteria when they have a full sufficiency of time in which to act.

OXIDATION OF SEWAGE.

Organic matter, theoretically speaking, may be oxidized, as regards sewage disposal methods, in one of several ways, as follows:

1. By direct chemical means.
2. By indirect chemical means, such as through the aid of absorption.
3. Dy direct biological means.
4. By indirect biological means, such as through the aid of enzymes.

There are, of course, other means of freeing sewages from part of their organic matter, such as sedimentation with or without the aid of coagulants, and also such as serving as food for worms and other higher forms of life than the bacteria. It is not the scope of this brief paper, however, to enter into those subjects directly, but rather to confine the discussions to a brief statement of our present understanding of the chemistry and biology of the principal sewage processes. The several means of oxidizing the organic matter of sewage, so as to guard against putrefaction and to obtain a product which is truly stable and nonputrescent, will be taken up in turn, as follows:

DIRECT CHEMICAL OXIDATION.

Dozens of investigators in the field of sewage purification have made tests in various parts of the world with regard to the effect upon the organic matter in sewage of a liberal application of atmospheric oxygen, such as is secured by forcing air through the liquid.

Usually there is a small quantity of organic substances of an unstable nature, in a gaseous or soluble form, which is removed by the application of air. How far this is direct oxidation, as distinguished from a physical removal of gases, is not definitely known. Some readily oxidized gases may quite likely come from intestinal discharges and disappear on the application of air. As a general proposition, however, it may be stated without qualification that the organic matter in sewage is not capable of direct oxidation by atmospheric oxygen.

This statement must not be confused, however, with the question as to whether or not sewage is rendered more stable by saturating it with atmospheric oxygen. Unquestionably, the more oxygen a sewage contains, whether it comes from the atmosphere or from oxidized salts such as nitrates, the more stable it is and the longer the period of time that is required for the sewage to reach a putrefying condition.

Thus, if a given sewage should contain 100 parts per million of "oxygen consumed," expressed in units of oxygen, which the bacteria would require to convert all of the organic matter to a stable form, then it is seen that if 10 parts or 20 parts of oxygen were to be introduced into the sewage, decomposition could proceed for some little time without putrefying conditions arising and, in absolute terms, the sewage treated in this manner would contain less "oxygen consumed" than would the same sewage without such treatment.

However, this leads us into the question of biological agencies which will be taken up later. Here it is sufficient to reiterate the statement above made, namely, that by direct oxidation with atmospheric oxygen the organic matter of sewage is but very slightly reduced, although its stability may be insured to a greater degree for some little period or time.

One additional comment may perhaps facilitate the present understanding of this subject by saying that even hypochlorite of lime and some other chemicals which are capable of releasing oxygen in a nascent or atomic form are scarcely capable of instantaneously oxidizing a substantial portion of the organic matter in sewage. This is substantiated by the ease with which the most powerful oxidizing chemicals may be detected in sewages when slight quantities of the chemical are added in excess of that needed to combine with small amounts of instable substances. Even prolonged boiling with powerful chemicals does not oxidize the main bulk of the organic matter.

Perhaps the most striking illustration of the failure of atmospheric oxygen to oxidize organic matter in a sewage-polluted water, was the observation of the late Prof. Albert R. Leeds, who found that there was no measurable difference in the organic matter of the Niagara River water before and after passage over the Niagara Falls.

INDIRECT CHEMICAL OXIDATION.

When sewage passes quickly over the surfaces of filters containing gravel or stone of considerable size, it is found that when the filters have become "ripened" the organic matter is directly oxidized to a considerable extent in an almost instantaneous fashion. Our knowledge of this phase of filtration is largely due to the efforts of Dunbar, who has shown that when sprinkling filters or contact filters are in good working condition, the gelatinous coatings seem to absorb atmospheric oxygen within their pores so that the organic matters passing over the surfaces are oxidized to a considerable degree.

It is unnecessary to enter the technical detail of this feature other than to show the importance of atmospheric oxygen and of using it to advantage by keeping the pores of a filter charged with it at all times rather than endeavoring to accomplish oxidation directly through aeration with atmospheric oxygen.

DIRECT BIOLOGICAL OXIDATION.

Certain species of bacteria unquestionably allow certain kinds of organic matter to become oxidized as the result of the direct action of the protoplasmic activity of the biological cell. For instance, sewage obtained fresh from the household and containing the oxygen of the water supply (of which it is largely composed) will show tremendous growths of the bacteria naturally present in the sewage. Among the results of this bacterial activity will be the oxidation of the carbonaceous matter to carbon dioxide. Some of the hydrogen, also, seems to oxidize to water. Other constituents of the or-

ganic matter seem to be released by cleavage or otherwise. Nitrogen, for instance, seems to be released in such a way that it combines with some of the hydrogen to form free ammonia. Sulphur apparently is released in the presence of oxygen as a cleavage product, although our knowledge of this element is not nearly so clear in connection with oxidation as it is with reduction. While it is probably released by cleavage in an oxidizing fermentation, it is also likely that the sulphur is oxidized to sulphate so that sulphuretted hydrogen does not appear as a conspicuous feature of fairly fresh sewage.

The main point that we do know thoroughly well, both from laboratory experience and from a study of sewage purification plants on a large scale, is that organic matter, in the presence of oxygen and of the kinds of bacteria that seem to establish themselves, undergoes a substantial oxidation. This is true particularly of the nitrogenous organic matter which passes through the well-known cycle of organic nitrogen, nitrogen as free ammonia, nitrites and nitrates. In the last form it is in the state of highest oxidation and this is the measure used for recording the degree of oxidation which has taken place in many styles of filters.

So long as bacterial oxidation takes place with the sufficient formation of nitrates, there is no fear as regards putrefactive odors from the effluent of a well-managed sewage disposal works.

INDIRECT BIOLOGICAL OXIDATION.

Some bacteria of an oxidizing nature accomplish the result, as above stated, through the direct protoplasmic action of the bacterial cells. Other bacteria do their work indirectly by excreting certain soluble chemical products known as enzymes and which, under conditions not known in all of their details, will produce a variety of chemical changes, amongst which may be mentioned oxidation.

FACTORS CONTROLLING BACTERIAL GROWTHS.

It is well to look somewhat into the conditions that affect the growth of bacteria since it is known that directly or indirectly bacterial growths have so much influence in the purification of sewage either for good or bad.

In the first place it is to be borne in mind that the amounts of organic matter in all sewages and many sewage effluents are very great, in fact, many times greater than is necessary to serve as a food for millions of bacteria per cubic centimeter. In fact, experiments made by the writer at the Lawrence Experiment Station more than 20 years ago showed that it was scarcely possible by distillation to obtain water so free from organic matter that it will not serve as a food for these tiny cells one twenty-five thousandths of an inch or so in size.

When bacterial growths come to an end in sewage and sewage effluents it is not because of lack of food, but for the reason that their environment becomes unfavorable owing to the amount of acid or other by-products that are secreted by bacterial cells in the process of their growth. In other words, bacteria come within the scope of that rule so generally applicable to living matter, namely, that life comes to an end when the growing cells are not freed in their surroundings from the products of their own growth.

To the laboratory observer this is well illustrated by a series of simple experiments, such, for instance, as the continuance of the fermentation of various carbohydrates resulting from artificial changes either in the acidity or the alkalinity of the liquid. Another simple observation noted in the early days of the Lawrence Experiment Station was that the boiling of ordinary river water caused it to serve as a medium for prolific bacterial growth, far beyond the limits of any bacterial growths noted in the unboiled water in question. This is detailed in the 1890 report of the Massachusetts State Board of Health, Part 11, page 593.

The explanation of the boiling experiment with Lawrence water is doubtless associated with the destruction of toxines which are products of decomposition that are unfavorable or inhibitive as regards the growths of the bacteria in question. This calls for a mention briefly of the important elements of symbiosis and antagonism with respect to the behavior of bacteria as they live in the organic matter of sewage and sewage-polluted waters. Symbiosis refers to the favorable influence which some species of bacteria have on the growth of other species. Conversely, antagonism refers to the retardation which some species of bacteria have on the growth of others.

Bacterial antagonism is doubtless of prime importance in explaining the fact that the specific germs of certain intestinal diseases, such as typhoid fever, not only do not multiply in natural waters, but will live, as a general proposition, for the shorter period of

time in those waters which contain the greater amount of organic matter and the greater bacterial flora.

Before dismissing the subject of bacterial oxidation and passing to that of bacterial putrefaction, it may be stated briefly that bacteria are divided into two classes, namely, the aerobes and the anaerobes. The former grow in the presence of oxygen and the latter in the absence of oxygen. On strict lines, bacteria are divided into obligate aerobes, obligate anaerobes, and an intermediate or facultative class that can adapt itself to growing in either condition. Many of the sewage bacteria naturally being of intestinal origin, come under the facultative class and can adapt themselves to growth either in the presence or absence of oxygen.

It is possible to conceive that some suspended matters, such for instance as particles of feces, may contain bacteria which are thriving as anaerobes, although the particle of feces may be surrounded with water from which the dissolved oxygen has not been exhausted by the aerobic bacteria growing therein. As a broad practical proposition, however, it may be said that bacteria in sewage or a sewage effluent proceed either upon an aerobic or anaerobic basis. By that is meant that sewage decomposes through an oxidizing fermentation so long as oxygen is available either from atmospheric oxygen, nitrates or any chemical compounds which will release oxygen. When oxygen becomes exhausted the bacterial flora adjust themselves to the new environment and the anaerobic bacteria proceed with the reducing or putrefactive fermentation.

One of the most important observations ever made at the Lawrence Experiment Station was a demonstration of the fact that so long as some oxygen is present at all places and at all times within the filter, oxidization processes due to bacterial action directly or indirectly proceed at substantially as high a rate as if the bed were saturated with atmospheric oxygen instead of being provided with only a small supply. (See Massachusetts State Board of Health Report, 1890, Part 11, page 703.)

(This paper will be continued in a future number.)

The Squaw Creek Improvement at Lawton, Okla.

By Z. M. Scifres, City Engineer

THE city of Lawton, Okla., with a population of about 10,000, drains into Squaw creek, a stream about twenty-five feet wide and six feet deep where it winds its way snake-like through and across the southern portion of the city. The ground is flat on each side of the stream back for an average distance of about 600 feet. The greater part of the city lies north of Squaw creek on a gradually sloping hillside, rising about 80 feet to the mile, while the rise on the south side is much greater, yet gradual.

The drainage area of this creek above the city is approximated at 4,000 acres. The outlets for the storm water sewer system for the entire city were made into the old channel of Squaw creek, one outlet (48-inch brick sewer) emptied into the old creek a short distance below the west boundary of the city, and the other outlet (62-inch brick sewer) was designed to empty farther down the stream near the east boundary line.

On account of the very tortuous course of this creek, its uneven bottom and obstructed flow through the channel, due to rubbish, brush, etc., frequent overflows occurred during heavy rains, doing much damage to the surrounding property and shutting off that portion of the city lying on the south from the main part during such overflows. During the dry seasons pools of water were held by low places in the bottom of the creek and these, becoming stagnant, created a condition menacing the health of the neighborhood.

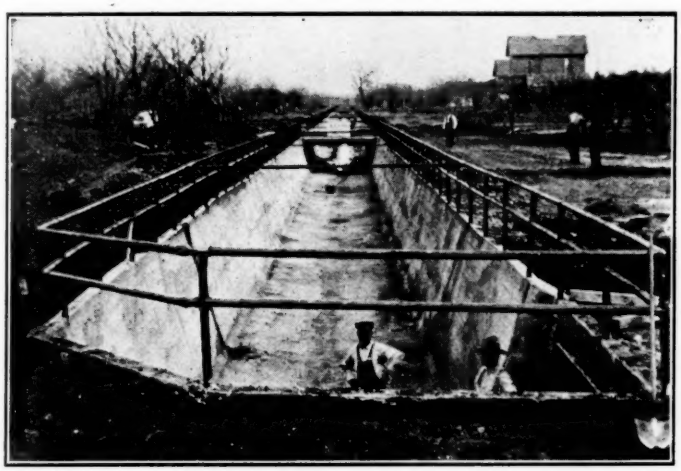
After many complaints from the citizens suffering these inconveniences, an attempt was made to partially remedy the condition by straightening the course in the extreme cases and filling the pools at as little expense as possible. But this was of no avail, and it was soon found that an improvement of a more permanent nature was absolutely necessary, as that portion of the city lying along this stream was becoming very valuable on account of its closeness to the business center.

About four years ago bonds were issued to improve Squaw creek, but the amount of the issue was found insufficient to meet the demands, and because all the property could not receive a portion of the benefits to come from the expenditure of this amount, some dissatisfaction arose over the proposed improvement, and the whole affair was dropped at that time. A second bond issue of $40,000 was voted about a year ago and plans were made to cover as much of the improvement as possible with this issue.

The city engineer was placed in charge of this work. Cross sections were taken 25 and 50 feet apart on various routes and all information as to existing conditions was obtained. It was decided, after thorough investigation, that the route should be along I avenue from the point where the creek touched the avenue between Second and Third streets to the point where the creek crossed the avenue, between Eighth and Ninth streets, and from these points the route would follow the general direction of the old channel of the creek, making the course as straight as possible. The street grades on I avenue and all cross streets had been previously established so that all street drainage was to the avenue, making this the proper route to be selected.

A plan for an open conduit of concrete bottom and sides such as shown was adopted. The conduit is eleven feet wide at the bottom and sixteen feet wide inside measurement at the top. Concrete-steel bridges span the conduit at each cross street and at alleys, the widths of the bridges on the streets being sufficient to include the sidewalks. A double railing of 2-inch gas pipe extends along each wall of the conduit and curb of the bridges, enclosing each block of the conduit from bridge to bridge.

I avenue is 80 feet wide. An ordinance was passed establishing the tree lines, sidewalk lines and curb lines on this avenue so that there would be a driveway approximately seventeen feet wide on each side of the conduit. The top of the conduit walls extends three inches above the crown of the street, forming a curb, in the same manner in which a center parking is enclosed in a pavement.



STORM WATER CONDUIT, LAWTON, OKLA.

At each bridge provisions for catch basins and outlets for future storm these outlets were provided at various places for the purpose of draining water from the old channel. However these outlets were planned only for sewers were made. In addition to temporary arrangement while the old creek was being filled.

The plans were approved by the mayor and council and contract was let to E. R. Kerby, a local contractor. Work on the actual construction began about the first of last November and was finished the latter part of January. Excellent weather conditions pre-

vailed and the work was carried on at a very rapid pace.

Earth from the excavation was deposited along the banks of the old creek and in some places even in the old channel. Some risk was taken in the latter case, but connections with the stream were made in due time to avoid damage from obstructing the flow of the water.

A varying depth of the conduit, a constant width at the bottom and a constant width at the top made it somewhat difficult to design a form for use in the construction of the concrete walls. However, this difficulty was overcome by making the form for the inside walls in two sections, so that a slight change in batter could be made to secure the necessary width at top of the walls. A set of standard cross-struts were made in two sections also and these held the wall forms in a very rigid manner. Where possible the sides of the excavated ditch were trimmed and these used as back forms. In other places back-lagging was necessary. Sufficient amounts of these forms were made so that one set was being filled while the concrete was setting in the other. The bottom of the conduit was constructed in advance of the walls. The concrete mixer was moved along the side of the conduit and the concrete was run through an inclined trough into hand-cars and these carried the concrete to its place in the bottom or walls. During the construction of the walls runways were supported by the struts which braced the wall forms.

Expansion joints one inch in width at intervals of 100 feet were made by inserting a one-inch board, which was withdrawn and the space filled with an asphalt filler. The joint extended across the full section of the conduit and was supported by a six-inch concrete slab constructed in advance of the conduit proper.

ROOFING PORTION OF STORM WATER CONDUIT, LAWTON, OKLA.

By means of wooden pins holes for the posts for gas pipe railing were made. A crew cut the pipe and set the railing after the concrete walls had properly hardened for this work. A second crew followed, doing all the remaining back-filling, shaping up and placing the work in a presentable condition.

Since the conduit has been completed the old channel has been filled and the property once taken up by old Squaw creek is being reclaimed and improved extensively. It is proposed to extend the conduit to take the place of the tortuous channel in the remainder of its course through the city.

Hydro-Electric Practice

By H. A. von Schon, M. Am. Soc. C. E., Consulting Engineer, Detroit, Mich.

The Power Plant Equipment

DIVERSION works. These may be an open channel or canal, a timber flume or pipe line, all serving the purpose to divert the water from the upper pool to the power station located at some point below the dam.

Diversion canals consist of bed, banks and superbanks, and their appurtenant works are the intake, headgates, waste weirs, culverts and bridges. The defects occurring in these are leaks, subsidences of banks and superbanks, erosions, damages to gates and bridges.

Leaks from canals, cut through lime or sandstone formations, may be due to the water finding passage through the stratifications. When the canal location is with or against the dip of the rock, the strata run out across the bed at intervals depending upon the thickness of the ledges, and these are places of probable leaks, as the level in the canal is probably considerably above that of the stream from which the water is diverted, and may be in close proximity to it.

Pipes are the last type of diversion conduits and are then known as pressure lines. These may be of wooden-stave, steel-plate, riveted or welded, and concrete-steel construction. The defects in pressure lines are chiefly leaks, sedimentation and distortion of flow section. Leaks are due to the opening of joints, which may be caused by settlement or faulty riveting, and can only be effectively remedied by emptying the line and resetting of rivets. Sedimentation reduces the flow area, increases the velocity and thereby the friction head. Mud boxes should be arranged at intervals of 1,000 feet to flush the silt out. Distortion of section is due to settlement of pipe and can only be remedied by withdrawing the water and reshaping, though this is not a serious defect. When pipe lines are laid with proper gradients, air cushions will not form; in the event that it becomes unavoidable to run lines with rises exceeding ten feet above the hydraulic gradient, air valves must be arranged at the peak of the rise and these should be frequently tested. Properly designed pressure lines are provided with stand pipes of ample dimensions, and in that case the pipe will not be injured by water-hammer. All this applies to the different types of pipe lines, excepting that leakage from wooden-stave pipes is generally arrested by the tightening of the steel bands at the point of leak, while there is no remedy for leakage from concrete pipes. Metal pipe must be kept well coated, preferably with a good quality of graphite paint.

The power station is located at the dam or the terminal of the diversion conduit. In the first position it may receive the water directly from the upper pool to form a forebay guarded by headgates. When taking water from the pond the power station stands on the dam alignment; when fed from a forebay it stands at some angle to the dam, the forebay paralleling it on the land side. In either position the power station is exposed to all the consequences of the fluctuating head and flow and, when on the dam alignment, to those growing out of floatage accumulations.

The power station rests upon a substructure whose upstream part, excepting when water enters in pipes, fills the office of a dam and is subject to the defects heretofore outlined for that structure. The superstructure houses the equipment and is not exposed to hydrostatic pressure. The power station proper is not likely to develop any serious defects unless there be leaks beneath or around it from the forebay, and their treatment must be by means of remedies already detailed. It is assumed that the walls and floors are properly designed not only to support safely the structure and equipment but also to be rigid against vibration.

The pit and tailrace are part of the power station, forming the exit passage of water discharged from turbines. The first is arranged in the substructure of the station, the second in the river channel below the power station. No serious defects are to be expected in either of these when, by proper design, they are of ample area and depth. When the equipment consists of several units, some of which are operated only for the generating of secondary power from higher than

normal flow, it may be found that the tailrace under and from the idle units becomes silted, thereby reducing the depth under draft tubes to such an extent that the outflowing water backs up and reduces the effective head. The ready remedy is to operate each unit alternately to avoid long periods of idleness.

The equipment consists of the hydraulic, electric generating, auxiliary plant and electric transmission. The first two are always housed in the power station, the third may or may not be, while a portion of the fourth is also there located. All equipment is generally subdivided into units, those of hydraulic and generating electric corresponding in capacity, while the auxiliary installation may conform to the hydro-electric unit characteristics or differ, which is also true of the transmission plant as far as it relates to the transformers. The maintenance and operation of the equipment is wholly of a mechanical character and involves details which could be adequately treated only in a large volume, which will not herein be attempted. Only those essentials which relate chiefly to the hydro-electric end of it will receive attention with some general outline of the economical constitution of auxiliary power installation.

The hydraulic equipment consists of the turbines and governors. Reaction turbines are drowned, in open chambers or bays or encased in draft chests, so called, into which the water is fed by pipes; shafts may be horizontal or vertical. In either event the most frequent troubles are caused by floatage, principally small blocks of wood which find their way into the turbine runner, blocking it or chipping its buckets. This is a common occurrence when lumber mills are located on the stream above, and can be guarded against only by frequent raking of trashracks, which should contain an especially close-spaced section from low to high flow surface. Reaction turbine gates are of cylinder, register or wicket type, the last of which is more likely to develop leakages with time than the first two. Turbine gate shafts will develop defects before any other part by wear in the bearings, which have to be relined when this occurs. The causes of ice interference have already been mentioned; when anchor ice blocks the turbine gate opening, the safest method to secure relief is to close the penstock gate and disperse the ice accumulations by mechanical means or steam. If this is attempted by operating the turbine gates it is quite likely that some of the gate riggings will be injured and the turbine put out of commission for repairs. On multiple horizontal turbine lines the shafts may bind because of the uneven wear of some of the lignum vitae blocks. These are adjustable. If the stream carries much silt the runner blades will be ground off, thus enlarging the normal clearing between runner and case ring and increasing leakage. All means of intercepting sand before the water reaches the turbine should therefore be exhausted, as there is no remedy afterwards excepting runner renewal. Erosion and pitting of the runner blades is likely to develop when their design is faulty. When turbines are cased a pressure-gauge should be installed on the top of the draft-chest and its hourly reading recorded in the log. So should the gate openings and speed be subjects of hourly measurements and entry and water-gauges should be maintained in open penstocks. Impulse wheels receive the water from nozzles and are free from injuries caused by floatage or from interruptions by ice. The buckets, or cups, have a short life compared with that of reaction runners, but are readily renewed. Turbines should be frequently examined, and, by keeping a careful record of gate openings, active head and output, any considerable efficiency loss is readily detected, when the cause should be determined and corrected. The draft-chest, supply penstock and draft-tubes should be kept well coated with a suitable paint.

The turbine speed is controlled by hydraulic or mechanical governors, which regulate the supply of water passing through the gates to the runner or, in some later types, the head by admitting air into the draft-tube. Governors should be adapted to the speed regulation requirements of the plant, which are influenced by the character of the current service and load fluctuations. Governors require the same intelligent care as does any precisely operating machine.

The electric-generating equipment consists of exciters, generators and the regulating devices. Exciters are direct-current motors required to excite or magnetize the field magnets. These may be driven by individual turbines or by belting them to the generator or turbine shaft; their speed is generally three or four times that of the generator. Exciters are readily maintained in efficient operating condition; their only parts requiring frequent attention are the commutator brushes, which are adjustable.

The generators, which in hydro-electric plants are most generally of the alternator type, are not likely to develop defects, provided they are not overlooked beyond the safe heating limit. The armature is the part which may become injured by overheating, and it is proper practice to keep in reserve an extra one at the station.

The regulating devices are assembled on what is called the switchboard, generally a stone panel, on which are mounted the instruments which measure and indicate the exciter and generator output characteristics. When properly installed these will require little maintenance attention.

The important feature in the operating of the electric-generating equipment, whence the current is transmitted to a distant point, is to secure the best constant harmony of output characteristics of the different units. This is accomplished at the starting of a unit by aid of the governor, whose speed-balls can be standardized for the desired regulation scope, but, as the load and the power-generating factors fluctuate, it requires more or less constant attention. All electrical equipments need "blowing out" at frequent intervals, for which purpose a suitable air compressor should be installed, which is motor driven.

Auxiliary power equipment may or may not form a part of the hydro-electric station's outfit, but no station should be without some electric-storage capacity for station operating purposes, such as assisting in the regulation of the voltage on exciter outlets, operating of high-tension switches, and lighting the station. A storage battery will always prove a resourceful investment by taking care, in whole or part, of peak loads and supplementing the exciter units in case of need. Storage batteries require constant operating care in charging and proper maintenance of their elements. They should be housed separately from the other equipment, where the temperature may be regulated by the aid of motor-driven fans. When neglected the depreciation of storage batteries may become high.

The location of stream auxiliary should be decided largely by the conditions as to economical fuel supply, and in most cases these will point to the service rather than the hydro-generating end. The capacity of the auxiliary plant should be such as to guarantee the continuous power output which may be realized from the maximum hydro-motive equipment by supplementing deficiencies caused by flow and fall reductions. The auxiliary plant units should always harmonize with those of the hydro-electric installation. The make-up of the steam plant may differ greatly. The capacity being fixed upon, the steam consumption of the prime movers and auxiliaries must be determined in order to decide upon boilers: 0.73 boiler horsepower are required per kilowatt output, and 10 square feet of water-tube boilers heating surface per boiler horsepower. The boilers should be provided for each prime mover and one extra prime mover unit beyond the required capacity. The plant should be located convenient to ample water supply, and fuel tracks and fuel and ash handling should be planned for all obtainable economies. Steam turbines are the best prime movers, those of horizontal type with coupled generator mounted on the bed-frame.

Cost of steam auxiliary plants and of their output is an important topic when the provision of an auxiliary is to be determined from a searching analysis and when efforts are made to convince steam power users that it is much more costly than they believe and that the hydro-electric power current will bring a great saving to their business.

The steam engine or water turbine effective unit output is the mechanical horsepower which may be converted into electric horsepower with the loss of ten per cent. The commercial unit of electric energy is the kilowatt (1,000 watts), and, as one horsepower equals 746 watts, a kilowatt represents one and one-third electric horsepower or about one and a half mechanical horsepower. The final commercial measurement of electric service is the kilowatt hour, combining quantity and time of service, and this is therefore the proper comparative unit basis of power cost. The cost of power in manufacturing establishments is, as a rule, not definitely known to the operators. In most of them, no doubt, the total cost of the manufacturing product is conclusively established, but the segregating of the total into the component items, especially as relating to power, is only rarely sufficiently detailed. And it is therefore not to be wondered at that the actual cost, where generated by the plant, is greatly underestimated. The items of fuel, wages, oil and waste are probably entered in the power account, but those of maintenance, repairs, depreciation, interest on plant's cost, taxes, insurance, etc., are rarely found properly apportioned.

Transmission plant consists of line

and equipment. The maintenance of the line calls for its constant inspection. When the supports are steel towers they need repainting, unless they are constructed of galvanized material. Cross-arms, pins and insulators must be maintained at all times in best condition, and damages from storms promptly repaired.

Transformers should be separately housed from the station equipment.

The substation forms the terminal of the transmission line, where the hydro-electric product is received, transformed, converted and distributed for service. Its electrical equipment consists of stepdown transformers, oil switches, converters, regulating devices arranged on switchboards, which call for the same intelligent maintenance as the generating equipment.

The operation of a hydro-electric plant should be carefully systematized in order to secure the best results with economy. It is logically divided between the major parts of the plant, the hydraulic works, generating station and transmission, with substation as its destination. A comprehensive system of records kept separately for each of these is indispensable to satisfactory and economical results, and the old adage, "A stitch in time saves nine," applies to no other industrial property more forcibly than to a hydro-electric plant.

It is poor economy to entrust a cheap man with the charge of so costly a property where a good salary may be saved for its owners by competency, system and proper management.

Public Gain From Improved Efficiency of Electric Lighting*

By William H. Blood, Jr., Boston, Mass.

THE expression that "we make our profits from what our fathers wasted," is not a platitude. It is a scientific statement capable of demonstration. It is particularly applicable to the electric lighting industry and we are not obliged to go back even to the days of our fathers, for all of the important improvements have been made in the past twenty years.

These improvements have not been brought about by accidents or by revolutionary inventions or by chance discoveries, but have been secured through careful study by educated men applying scientific methods to the working out of definite problems. That some of the results accomplished are almost miraculous, we are forced to admit; but that they are haphazard we emphatically deny.

At the present time, when so much is being said about "efficiency" and "scientific management," and when the public service corporation is accused of being "greedy" and "unscrupulous," it may be well to spend a few moments in considering what the application of science to the electric lighting industry has accomplished and to what extent the public has been benefited thereby.

In 1888, two of us, for our thesis work, tested the largest dynamo that the Institute of Technology possesssed, and found the highest ratio of electrical output to mechanical input to be about 70 per cent. Today, machines of this size operate at about 85 per cent., while larger units give efficiencies of 95, or even as high as 97 per cent. Assuming that this improvement in efficiency amounts to 25 per cent., on the average (which is a low estimate), it would mean that we are today saving 25 per cent. of the fuel that we should have burned had there been no improvement in electrical efficiency since the year 1888.

Applying this figure to the industry as a whole, and basing our estimate upon figures given in the Census Reports on the cost of fuel used by the electric light and electric railway plants in the United States, we prove, without fear of contradiction, that our electrical engineers have brought about the conservation, for future generations, of some $12,000,000 worth

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of coal per year, and this solely on account of a single item—improvement in the efficiency of electric generating machines.

This improvement has been accomplished partly through the increase in the size of the units. The first commercial electric light plant in Boston, built in 1886, contained six machines having an aggregate capacity of about 230 h.p. Two of them were of 15 h.p., and four of them about 30 h. p. In 1888 the largest electric generators were of 100 h.p., and they were regarded as monsters. In fact, one machine of approximately this size was universally called a "Jumbo." It was thought that the limit in size had been reached when we built machines of 100 h.p.; in fact the writer of this article, when it was planned to build a 200 h.p. machine, protested, on the ground that if anyone required such a large amount of power he could readily use two 100 h.p. machines. Today, 15,000 h.p. machines are common, and we are beginning to install units of 25,000 h.p. This simply represents the evolution which the trained engineer has brought about. The new 25,000 h.p. generators, besides being more efficient, are much more reliable, and are little, if any, more complicated than the older and smaller machines.

Only a few days ago, it was my privilege to examine a plant built in 1893, in which the original installation consisted of several 3,500 k.w. engine-driven units. A year or two later, the plant was enlarged by adding 5,000 k.w. turbines. Today, the 5,000 k.w. machines are being replaced and upon the same floor space are being installed 15,000 k.w. units. These 15,000 k.w. units occupy less than one-half the room occupied by the original 3,500 k.w. units, which means that the operating company is getting eight times the capacity on the same floor space.

One of the early electric power plants, with which I had some connection, contained twenty dynamos of 100 h.p. capacity each, which gave a total capacity of 2,000 h.p., and the floor space required for the entire plant, including boilers and engines, as well as dynamos, was 9,000 square feet, which is equivalent to 4.5 square feet per horse power of capacity. This same company is today building, under the supervision of some of Tech's illustrious alumni, a new station which is to have an ultimate capacity of 140,000 h.p., which will require but slightly in excess of one-half a square foot per horse power of capacity.

The first plant represented an investment of approximately $225 per horse power, while in the latter case it will be about $45 per horse power. Had there been no improvement made along this line, and had the company been obliged to increase its capital account on the basis of $225 per horse power up to its present total capacity, it would have required an additional investment of some $12,500,000, which would entail additional annual interest charges of $750,000. But, as a matter of fact, this additional charge is obviated because the electrical and steam machinery has been improved and the costs of the plant have been reduced.

In the early days dynamos were of the belt-driven type, which means that the power was transmitted from the engines to the dynamos by heavy leather belts. In many cases the engines were belted to long shafts and the power again transmitted by other belts from these shafts to the dynamos. All this entailed not only large losses of power but heavy maintenance charges. This, in recent years, is eliminated by having the dynamos directly connected to the engines which drive them. Nor is this all. Instead of the simple, high-speed engines, which generally racked themselves to pieces, we now have compound condensing engines running at low speed with better than clocklike regularity.

A still further improvement in power-plant design requires the installation of steam turbines of either the horizontal or vertical type. These are self-contained, rotating units which utilize the expansion of the steam to convert potential into kinetic energy, thus obtaining much higher efficiencies than is possible with prime movers of reciprocating types. The steam room, as has been shown, uses higher turbine, besides requiring much less steam pressure and higher vacua on its condensers, and is, consequently, more efficient, and because of its constant rotating motion is better adapted to the generation of electricity than the old reciprocating engines.

There has been a great development in the boilers used in power stations. Instead of units of 100 to 125 h.p., today 600 h.p. is in general use, and boilers up to 2,000 h.p. have been made. In the old tubular boilers, 80 to 100 lbs. was the common pressure used. This was increased to 125,

then 150, and in the water tube boilers to-day 200 is generally used. Improvements in superheaters, combustion chambers, automatic stoking devices, condensers, ash and coal-handling machinery, apparatus for analyzing flue gases, besides other miscellaneous devices, have all had their effect in cheapening the process of converting the heat units of coal into steam.

Turning again to the electrical end of the power station, the switchboard of today, though a much more elaborate affair, is, when once installed with its remote control switches and automatic regulating and protecting devices, simple of manipulation and arranged to give the plant the greatest flexibilty of operation.

With the increase in size of the units and with the development of the modern switchboard, has come a decrease in the number of operators needed, so that in the dynamo room in a plant of 5,000 h.p. capacity today there would be required two or three men on a shift, while two decades ago eight to ten men, at least, would have been required.

Now let us see how all these improvements affect the operation of a power station. We find, in looking up the back records, that in the early days it took, as a rule, ten or more pounds of coal to produce one kilowatt hour. In many modern stations is requires only three pounds of coal per kilowatt, and in some cases even less than this. This means that only 30 per cent. as much coal as was demanded twenty years ago is now used to produce a unit of electricity.

What effect does this have on the cost of electricity? Take for a concrete example an electric light plant of 5,000 k.w. capacity. Its first cost, including distributing lines, would be approximately $1,250,000, and under ordinary conditions the operating expenses, including taxes and depreciation, would be, say, 65 per cent. of this, or $202,800, which would leave for interest on investment and reserves, $109,200.

Now suppose that instead of having a power station which runs on three pounds of coal per kilowatt hour, it was like those in operation in 1888, and consumed ten pounds of coal per kilowatt hour. With the same output over 300 per cent. more coal would be required; or, without boring you with the details of calculation, instead of producing a return of 8¾ per cent. on the investment (which we assume is the same in both cases) there would be a deficit of about 6 per cent.; or, if you please, stating the results in another way, while the company has been making systematic reductions in the rates from 16 cents per kilowatt hour down to 10 cents per kilowatt hour, its stockholders have had to be content with a constant and low rate of return upon their investments. If you will study the records of the electric lighting companies given in the reports of the Massachusetts Gas and Electric Light Commissioners, you will find that this is exactly what has taken place in this state at least. During the last twenty years the rate of return on the money actually invested has not changed appreciably. As a matter of fact, it has decreased rather than increased, for electrical properties are fast getting out of the speculative class and are therefore satisfying their owners with a slightly lower rate of return.

A specific instance of this in the history of one of the larger Massachusetts companies may be of interest. In the first ten years of the company's existence, it paid dividends netting between 5 and 6 per cent., and the rate for electricity was then 25 cents per kilowatt hour. During the past few years the return has been about 4½ per cent., whereas the rates have been cut more than 50 per cent. and now the maximum charge is only 11 cents per kilowatt hour.

The effect, therefore, of all these improvements which have been brought about by careful scientific study and development, has been, by increasing the efficiency of the power stations, to reduce the cost of electricity to the public.

But we have not told the whole story yet. The development of alternating current apparatus has enabled the electric lighting companies to distribute their product from the power station to the consumers at a much less cost, and has made it possible to transmit it for distances which were not dreamed of in the early days. Twenty years ago what little electricity was used was distributed by direct current and the radius of activity was seldom more than half a mile, or a mile at the most. This forced the generating stations to be placed upon expensive land near the heart of the city, and since the voltage on a direct current system is limited it meant a large loss of power in transmission and required a large investment in copper. However, this has all been

changed by the development of alternating current apparatus, and we now have high voltage transmission and distribution at a greatly reduced cost. The introduction of this system has also made it possible to locate factories, mills, and shops anywhere, instead, as in the old days, of at or near the source of power. This one fact alone has had a wonderfully beneficial effect upon the entire industrial problem of the country.

High voltage transmission has further enabled us to utilize what were heretofore useless and almost inaccessible water falls. Without this development, Los Angeles would be forced to burn thousands of barrels of oil each day instead of using the mountain streams two hundred miles away for making her streets at night almost as brilliant as in the day. But for this development Seattle would not be able to utilize the melting snow and ice from the glaciers of Mt. Rainier to operate all her street cars and other public utilities. Without high-tension, alternating-current apparatus, Niagara power could not be transmitted and used in the Lake cities of Canada, or in Buffalo, Syracuse or Rochester. The utilization of Niagara power alone means a yearly saving of at least 2,500,000 tons of coal, or the conservation of $6,000,000 to $7,000,000 of fuel annually. The development of the high-tension alternating-current system has, therefore, not only been the means of reducing the cost of distributing electric power and of preventing the congestion of manufactories, but has also been a great factor in conserving our natural resources.

Turn now to the apparatus by which the consumer transforms the electricity delivered to him into light, heat and power. Here again scientific study and research have done much to increase the efficiency of the apparatus used. The reduced price of electricity by itself, therefore, does not indicate the total saving to the consumer. We have today arc lamps of more than 100 per cent. greater efficiency than those of a few years ago. Incandescent lamps in the early days consumed six watts of energy per candle power. This consumption was soon reduced to three watts per candle, where it remained for many years and seemed to baffle further reduction, but after years of scientific experimentation this has been reduced to one and a half watts per candle, and today we have the Tungsten lamp which consumes only one watt per candle, and a still further improvement is promised in a lamp which is to consume not over one-half a watt per candle.

Today we have in common use electric heaters, stoves, irons and other special heating devices, which a few years ago were commercially impossible. The general adoption of these household conveniences has been brought about, not altogether by the reduction in the cost of electricity, but to a large extent by the development of efficient and durable heating elements, which, thanks to our heating engineers, are now sold at reasonable prices.

Motors for transforming electricity into mechanical power have been perfected and their efficiency is now from 20 to 50 per cent. better than in the early days, and they are so designed and constructed that they may be applied directly to the machinery which they are to drive, thus obviating the expense of shafting, pulleys and belting.

While all of the matters thus far discussed relate to improvements which have taken place in the physical apparatus of the property, we must not fail to give due credit for the development of the electric lighting industry, and for the reduction in the cost of light, heat and power, to the scientific management of electric lighting properties, which have been specialized to a remarkable degree and carried on with most satisfactory results for many years, in spite of the fact that the term "efficiency engineer" is just becoming known to the public. The improvements in electric lighting properties have been due fully as much to the trained engineer who operates the property as to the engineer who plans it or designs the apparatus used in it. It is the operating engineer who, in many cases, has pointed out opportunities for betterments and has suggested to the designing engineer where economies and improvements could be made in the physical apparatus. It is the operating engineer who, by careful study of men, machinery and methods, has brought about economies in the production of electricity which have resulted in reduced costs. He has scoured the country over for keen, careful men and has enrolled upon his staff the pick of the country. He has instructed them in their particular duties and has educated them so that they have become experts in their lines. He has selected the best ma-

chinery and apparatus that could be designed, and when changes in the art have dictated he has been quick to reconstruct his plant so as to produce maximum results at minimum cost. He has tested, and continues to test, the coal which he uses to make sure that it contains the number of heat units which he pays for. He weighs every pound of coal which is put under the boilers and he watches like a cat the electric meters in his power station, in order that he may know at all times the exact output of the station. If the coal consumption is too high, he investigates and determines where the waste occurs. He analyzes all his costs and compares them with the results of previous years and with the records of other companies. Through a study of his costs he is able to determine a system of rates based upon costs which is equitable and nondiscriminatory. He has, in establishing these rates, automatically improved his load factor, or, in nontechnical language, has increased the average use of his plant, and this has necessarily brought about lower unit costs of the article produced. He has classified his costs as fixed and variable, the fixed including interest, taxes, insurance, depreciation and the like; the variable including fuel, labor, maintenance, etc., and by this means has been able to differentiate his customers, basing rates not only on the actual amount of current used, but upon the cost of the plant, which is to be reserved for the special service. By the use of proper meters he has made it possible for his customer to buy a measured service and so get away from the unjust and unscientific flat-rate system of charging.

He has established a nomenclature of his own, and methods of analysis peculiar to the industry. Whoever heard of a load curve, load factor, maximum demand or diversity factor until the trained engineer showed that, in studying the costs of the various kinds of service and establishing equitable rates, these were necessary.

The operating engineer has not only brought about a great reduction in the cost of electrical energy itself, but as the result of a scientific investigation of the customer's needs he has effected, through the use of suitable electrical apparatus, what is in reality a still further reduction in the cost of light and power to the consumer.

With his knowledge of the underlying principles of illumination he has been able to advise his customers as to the best arrangement of lights, so that besides producing artistic and pleasing effects he has obtained the results sought at minimum cost.

By a study of the application of power in industrial plants, he has made further reductions in the cost of power by the use of the "direct drive." This means that the motors which transform the electrical energy into mechanical power are of exactly the right size and speed and are connected directly to the machine which requires the power, thus eliminating all belt and other transmission losses.

In many other ways he has applied his knowledge of scientific principles to the direct benefit of his customers.

The wonderful advance which has taken place in the last twenty years in the electric lighting industry has been due to the combined efforts of the operating engineer and the designing engineer. It has been a gradual and steady evolution and is still going on. The industry itself has not reaped all the benefits, for while the returns on electric light investments have been sure they have not been as large as the dividends which the public has received in the reduced cost of electric light and power.

Twenty years ago electric lights were high priced luxuries, today they are inexpensive necessities. In this wonderful transformation Technology men have played no small part. The success of many electrical undertakings may be credited to them, for they have entered every field of the industry and have done much to improve the efficiency of the apparatus, to broaden the use of electricity, to reduce the cost of production, and to make what were formerly hazardous undertakings safe and sure investments.

Asphaltic Oils Economical Wood Preservers

By Frank W. Cherrington, Cincinnati, O.

ASPHALTIC oils were first tried as substitutes for creosote oil on account of the excessive cost of high-grade creosote at interior points. In the spring of 1902 the Santa Fe Railroad placed in an experimental track in Texas, ties treated with asphaltic crude oil. The conditions in this track were such that untreated loblolly pine ties would not last over eighteen months, nor the long-lived long-leaf pine ties scarcely over two years. The ties placed in this track were given all the asphaltic oil which they would absorb—some of them taking as low as eight and one-half pounds per tie, and others as high as sixty pounds per tie. In all cases this was the maximum quantity of oil the ties would absorb, being dependent, of course, upon the structure of the wood being treated. These ties have been examined annually during the past nine years. The last report stated that all of the asphaltic treated ties were found to be in a state of perfect preservation, with no signs of decay. The records show that these ties have already last over four times the life of untreated ties, and are still perfectly preserved. Several specimens have been examined, and it has been found that the sap wood filled with the oil clear to the heart wood, and after nine years of constant service under abnormal conditions, the heart wood was found to be as sound as the day the ties were treated. At the same time these ties were inserted in this experimental track, 196 untreated ties of white oak were placed in the track, and practically all were found rotten and removed after six years' service.

These tests were so encouraging that in 1909 the Santa Fe Railroad employed the exclusive use of asphaltic oils on a large scale at their plant in Albuquerque, N. M. Since that time they have treated three-quarters of a million ties annually with asphaltic oil. The above facts conclusively prove the efficiency, value and practical application of asphaltic oils for the purpose of wood preservation.

The asphaltic crude oils found in sections of the country other than California and New Mexico are highly inflammable and very volatile, and, in their crude state, are not applicable for use as wood preservatives in any process. For these reasons, it is necessary to refine the asphaltic oils appearing in such unlimited quantities in the Central United States, in order to reduce their inflammability, volatility and viscosity. By submitting these asphaltic crude oils to a process of refining, the residuum secured is very similar, and in most cases superior, to the oil used in the West for the preservation of ties. After years of exhaustive research Indian Timber-asphalt has been placed on the market as a representative of what may be accomplished in the refining of the asphaltic oils so plentiful in the central regions of the United States. It may be purchased at about 3 cents per gallon, f. o. b. refineries, in practically unlimited quantities.

The steam railroads, with thousands of miles of track to maintain and millions of ties to be renewed annually, are able to install expensive pressure plants for the treatment of a portion of their annual requirements at the expense of hundreds of thousands of dollars. The electric railroads and small consumers of railway ties have been obliged to purchase their supply of treated material from outside commercial pressure plants or to use the alternative of substituting time for pressure in either the more economical low-pressure method or the open tank or immersion process.

The open tank or immersion process of treating timbers is one which has been successfully used by consumers of treated materials to whom the cost and capacity of a pressure plant has been prohibitive. Coal-tar creosote has not been used extensively in this method because of its tendency to evaporate when exposed to the atmosphere at a temperature of 215 degrees Fahrenheit. Several mining companies in the East have overcome this difficulty by boiling their timbers in closed retorts and collecting the volatile components of the creosote by allowing the fumes to pass through a still immersed in cold water, and thus condensing the volatile vapors into a tank and again utilizing them by pumping the condensation back into the

original retort. Even with this method there is necessarily some loss by evaporation, as creosote will lose between 30 and 40 per cent. of its volume when exposed to the atmosphere at the above temperature. For this reason the use of creosote in the open tank process has not been considered by many consumers of treated materials to be economical, and since the advent of asphaltic oils as successful wood preservatives, their adaptability for substitution for creosote in this immersion process has been carefully investigated and substantiated.

The crude asphaltic oils of the West are exceedingly viscous and hard to handle by either the pressure or open tank equipment, but the refined asphaltic oils of the central United States have been found to be most excellent for use in this connection, as there is absolutely no waste by evaporation and no trouble whatever in their handling by the average equipment of any plant using either the pressure or immersion process.

Many preservatives are strongly advocated for use in the open tank process which have high boiling points and are non-volatile, but which call for an injection into the wood in small quantities, because of their extremely high cost. In treating timber with the best grades of creosote there is absolutely no question of the highest efficiency of the full-cell process, in which a maximum amount of creosote is injected. It is, therefore, reasonable to assume that the most efficient treatment with any other preservative would be one that would allow a maximum injection of preservative oil at the minimum expense. A superficial treatment with high-priced preservatives undoubtedly prolongs the life of untreated timber a few years by creating an antiseptic environment. In most cases the producers of high-priced wood preservatives contend that it is only necessary to immerse the timber for a few moments in a hot bath of oil and for a briefer period in a cold bath, in order to secure an absorption which would prolong the life of the timber indefinitely. But, as stated above, the most efficient treatment in any process has been found to be one that would allow a maximum amount of preservative to be absorbed by the timber. Low-priced asphaltic oils have been proven to be thoroughly effective wood preservatives when applied in maximum quantities by any process.

The rapid advancement of the preservative treatment is also greatly dependent upon the reduction in the initial cost of plant equipment necessary to secure thorough impregnation. With this end in view a plant was recently erected in Cincinnati consisting of two tanks equipped with steam coils and suitable lids for protection against inclement weather, a boiler and boiler pump, a stiff-leg derrick and derrick slings with which to handle ties in bunches of twenty-five at a lift. This plant has a capacity of 15,000 ties per month, and did not cost to exceed $3,000 complete.

The process used consists of immersing mixed oak, beeech, elm, gum, maple, etc., in hot oil at a temperature of 215 degrees Fahrenheit for a period of from eight to ten hours, dependent upon the previous seasoning of the timber. The steam is then shut off and the ties are allowed to cool in the asphaltic oil over night, when a drop in temperature of from 20 to 30 degrees Fahrenheit is recorded. The long hot bath at 215 degrees Fahrenheit heats the tie throughout and has a tendency to kill any germ life which may be present in the untreated tie, expands and expels any air which may be contained in the wood cells and boils out the moisture and sap juices. As the oil cools over night the cellular spaces within the tie contract, forming a vacuum which draws the oil into the wood by means of atmospheric pressure. In this way, the asphaltic oil takes the place of the air, moisture and sap which had previously been expelled in the boiling period.

The working tanks are carefully calibrated and readings of tank gauges and tank temperatures taken before the immersion and after the withdrawal of the ties. These readings are corrected to 60 degrees Fahrenheit, and as the number of ties, and thus the number of cubic feet entering each charge, are known, it is an easy matter to calculate the injection per tie or per cubic foot. This method of determining the injection per cubic foot of the preservative has heretofore been considered impossible with the open tank process. Checking the results secured from the calibration of the tanks by weighing individual ties has resulted in actual proof of its success. The average injection secured by this process at the above plant has been found to range between two and two and a half gallons per tie. The penetration secured on ties of mixed oak, beech, elm, gum and maple, etc.,

has been found to be most excellent on timber which has been air seasoned from four to six months. The actual costs of operation of a plant of the above capacity and design are as follows:

COST TABLE 500 TIES PER DAY.

		Per Tie.
2¼ gallons of oil at $0.035		$0.07875
Rental of ground		.003
1 ton of coal at $2.50		.005
Labor and superintendence—		
6 men at $1.75	$10.50	
1 superintendent	3.00	
1 engineer	2.50	
Incidental	.75	
	$16.75	.0335
Equalling a total of		$0.12025

(These figures are based on actual operations at the Cincinnati plant.)

The first cost of construction of such a plant could be easily reduced by many of the traction companies to $2,000 or $2,500 by placing the treating tanks adjacent to their power house, from which exhaust or surplus steam could be utilized for heating the oil. In this way the expense of boiler installation would be saved, besides securing a reduction in the cost per tie for treating by the elimination of fuel. If it were desired to lower the capacity of the plant from 15,000 to 7,500 ties per month, the first cost of erection could still be reduced by the elimination of one of the treating tanks.

Full sized, No. 1, first class ties of the above species may be secured along the right-of-way of any traction company, loaded on cars, at a maximum price of 30 cents each. In other words, by the erection of a plant cost-approximately $3,000, full sized, No. 1, first class, treated ties, of mixed oak, beech, elm, gum or maple may be secured at a total cost of 42 cents each, f. o. b. lines. Such treated ties would not have merely a superficial treatment, but would contain from two to two and a half gallons of heavy asphaltic oil, injected in a twenty-four-hour treatment, which would prolong their life many years beyond the eight-year life which is now obtained from the use of untreated white oak ties. The average cost of a white oak tie is 55 cents, and, as is well known, this grade of timber is becoming scarcer each year. Every traction engineer is surely familiar with the economies secured through the use of treated railway ties, as their use has been recommended by every engineering association and society in the country.

To reiterate:

First—Asphaltic oils have been thoroughly tried out and unquestionably proven to be efficient and economical wood preservatives.

Second—Asphaltic oils are obtainable in unlimited quantities and at exceedingly low cost.

Third—The cost of the less expensive plant equipment of the open tank or immersion type is comparatively low—the cost of a plant with a capacity of 15,000 ties per month ranges from $3,000 to $2,000, if surplus steam from power house boilers is utilized.

Fourth—Asphaltic oils are applicable to the open tank or immersion process of treating timber, because of their non-volatility and non-inflammability.

Fifth—The cost of white oak ties is approximately 55 cents, untreated.

Sixth—The cost of mixed oak, beech, elm, gum, maple, etc., ties, obtainable in such unlimited quantities along the right-of-way of every traction line, is approximately 30 cents, untreated.

Seventh—The cost of treatment per tie aggregates approximately 12 cents, bringing the cost of a full sized, No. 1, first class, treated tie to 42 cents, f. o. b. traction lines.

Therefore, well preserved railway ties, with a twenty-four-hour treatment and containing an injection of heavy asphaltic oil, in quantities of two or two and a half gallons per tie, with a resultant life at least equivalent to that of white oak, may be secured at approximately four-fifths the cost of standard first class, white oak ties. These comparative figures are based on actual costs of treated ties to individual traction companies performing their own treatment.

The Bond of a Road

By J. S. Robeson, Au Sable Forks, N. Y.

WHETHER the road is built of stone, of gravel, of sand-clay, of top-soil or of plain dirt, there is always in it, to a greater or less extent, in accordance with the particular materials used and the care with which it has been built, an adhesion or bond between the particles or pieces that form the body and the surface. The strength of this bond determines the value of the road.

More than fifty years ago the agricultural chemists in their study of the soil discovered that water has a very decided leaching action; that certain salts are thus extracted from the earth and that the degree or amount of this extraction is influenced, decreased or increased, by the absence or presence of certain compounds commonly found in the earth. Now, some of these matters capable of being thus leached or extracted by water are powerful adhesives. If it is borne in mind that all soil is but disintegrated, though sometimes, as well, decomposed rock, the possible connection between the knowledge of the agricultural chemist and the action that should take place in a stone road are seen.

It is well to confine this comparison, in this instance, to the macadam road surface, because that has been more carefully studied and is perhaps, therefore, better understood than any other style of road building in use today. It has been recognized for years that the wet-rolling of a macadam road was necessary in order to secure the most compact surface, and also that certain rocks would make such a dense road, while others, no matter how much they were wet-rolled, would never give this desired result. Analytical work in the physical and chemical laboratory eventually proved that the stones that made the well-bound road contained certain chemicals that did not exist in the stones that were used in the roads that failed to bind under the wet-rolling.

It has been thoroughly proven, by these and other tests, that the macadam road is held together by the two factors, (1) the mechanical mixture of the different sized pieces, so proportioned that the voids are well filled and the stones locked together in the arch, and (2) by the adhesive chemicals that are leached out by the water. These are rubbed off of the stone surfaces by the rolling during construction and the traffic afterwards, thus leaving fresh stone surfaces ready again for the action of the water, which as it sinks through the roadbed spreads out these binders and distributes them through the aggregate.

It has been distinctly proven that neither one of these two factors by itself and alone will give a road strong enough to stand the traffic. As a bit of circumstantial proof, note the English roads. They are often cited as being so good and so much better than those built during recent years in the United States. The casual road critic, and both the newspapers and the technical press are full of him today, invariably says that these good results are obtained because they have better road engineers than we, that they spend more money in heavy construction and better maintenance and then, if the critic be in a kindly frame of mind, he suggests that they are better because they are hundreds of years older. The English road engineers are good, painstaking, skilled men, but no better than those who are devoting their time to the work in this country. If, as is sometimes the case, the foundation is deeper and the road metal thicker than with us, it is not more than the greater traffic demands, and as to the great strength of the roads being due to great age, the most cursory study of English literature will show how few years have passed since the main highways of England were as bad as our worst dirt roads. With MacAdam came the first real roads for England and MacAdam is but little more than twice the span of a man's life behind us.

No, it is neither the skill, nor the cost, nor the age that makes the contrast between the American and the English road, but it is water, simply water. While the total rainfall during the year is not greater in England than on the American continent, there is the vital difference that in the United States the rain comes in great quantity at times with long dry spells intervening, while in England there is a little rain every other day. This lit-

tle rain every other day keeps the stone road always moist, and with this moisture and the roll of the traffic there is a constant increase of the chemical bond leached from the stone.

On one point does the critic's reference to the age of these roads apply, though not then in the manner intended. All English roads are protected by trees and age has perfected this protection. It is one of the great errors made in road building in the United States that the specifications for construction do not include tree planting and that the builders are allowed to destroy trees already growing along the road side. The stone road needs moisture, but only enough to continue the formation of the binder, so that there must be proper drainage to remove the excess of water and shade to prevent an excess of sun. The American roads have the drainage, but hardly a tree, whilst the English roads have both, and in those two are found the main reason for the superiority of the over-sea roads to those on this side of the Atlantic. The climate is different in the two countries. It would be impossible to exactly duplicate in one land the condition in any other land, but advantage may be taken of as much as can be transplanted, and therein lies some part of the failure in that the value of the road-side tree has not been appreciated.

As a further bit of practical circumstantial evidence as to the existence of this leached chemical bond, look at the many miles of macadam road that have been built with ¾ to 1½-inch stone, the voids filled with loam instead of with some screenings. In the making this loam is watered until it is mud and the mass wet rolled until solid. These dirt-filled stone roads are as good roads as the stone-filled stone roads in many cases, and yet there must be a great difference in the mechanical bond or interlacing of the stones.

While it is true that the decomposition of rocks and the consequent formation of the soil is mainly brought about by water action and it would, therefore, seem that all of the leachable bond had been removed in this process, the bare fact is, that not all of the bond-making substances have been removed, consequently the contact of the fine particles of the loam with the stone surfaces in the road, always in the presence of moisture, will start up the reaction and produce the bond in a greater or less quantity in accordance with the character of the stone and the soil thus brought into contact. This is a fact of far-reaching importance when considering the possibility of building elastic, firm earth roads under conditions where the expense of a stone structure is not warranted. The bonding materials thus produced have one characteristic that is vital to success in road work, the power to re-cement again and again. This power they possess in an almost infinite degree.

It is well known that the increased use of motor vehicles during the past few years and the further increase in their number that may be expected in the coming years have so changed traffic conditions as to make the good road surface of the past too weak to stand the strain placed upon it by the additional weight and speed of these conveyances. Putting aside all question of the dust, since that in itself is but the symptom and not the disease proper, the main thought has been that the trouble could be cured by an increase in the strength of the bond.

Of all the multitude of methods that have been suggested and tried there remain, speaking broadly, but two. In one of these, that of the bond and matrix, the best type example is that one known as the bitumen top surface. In this the stone for the surface is set into a bitumen mass as in a matrix. There is then but little of the mechanical bond due to the different sized pieces being forced and compacted together under the roller nor any production whatsoever of the bonding materials existing in the stone. The life of such a surface is dependent on the strength and elasticity of the bitumen material that coats and surrounds the stone particles and fills the voids.

In the other of the two methods, that of the increased natural bond, the best type example is that one known as the glutrin-water-bound road. In this the production of the natural bonding materials that exist in the stone has been increased and assisted to such a degree as to make a surface that will withstand present day traffic conditions.

The material used and the action produced are, in almost every way, the direct opposite of the other or bitumen type. This is distinctively shown, in one way, by the fact that water is essential for the proper and complete action needed in a glutrin bound road. This fact, coupled with its complete solubility in water, have caused many engineers to form an

erroneous idea regarding the permanency of its action. Experience, however, has shown that it is never completely washed out of the road bed, that it has a cumulative action, and that the amount required each year to maintain a good surface is but a fraction of the original application. This liquid, strongly adhesive in and by itself, is applied partly with the water during the wet rolling, the balance being sprinkled on the finished surface of the roadway. In addition to its inherent adhesive action, as of a gum, it exerts a certain influence on the leaching power of the water, causing a much greater production of the bonding materials from the stone or soil forming the bed.

Igneous and crystalline rocks are commonly used for road building and the feldspars are the most abundant minerals in these rocks. So abundant are they that collectively they form a very large part of the earth's crust. Now chemically, the feldspars are silicates of alumina, containing in addition soda, potash or lime, and from them come the powerful, re-cementing adhesives, the silicates of soda and potash, that act as the road bond. The feldspars decompose when exposed to the weather and produce the clays and soils. The decomposition by the weather is, in a sense, similar to the leaching action that occurs in the damp road, except that it is carried, in the course of a long time, to the complete destruction of the rock as a rock, leaving a residue of clay and sand, separated as two such named bodies perhaps, or mixed in varying proportions to form loam. Just as the agricultural chemist recognized that the presence of certain compounds in the soil made a difference in the leaching solution, so it has come to be understood that combinations of different stones would give a better bond in a water-bound macadam than when only one kind of stone is used. This fact is even more plainly noticed when glutrin is applied.

Now, while the exact reason for this is not known, it has been so clearly and frequently proved, that definite rules can be given, after an examination of the stones, for producing the result. The general method is to build the aggregate or body of the road of some tested stone containing feldspar, such as trap, gneiss, etc., this work being done in accordance with any good macadam specifications, suited for the amount of traffic in that particular instance. When the wet rolling commences, glutrin is mixed with the water, and when that is finished in a satisfactory manner, limestone screenings, containing the dust, are scattered over the surface, and the sprinkling with glutrin and water, about half of each, is continued until the road has absorbed about one gallon of mixture to each square yard of the surface over about two-thirds of its width. In localities where limestone is the cheaper the method has been reversed, so that the limestone forms the aggregate and the screenings and dust scattered over the top are of feldspathic rock. In either case, the result is a cement-like surface that resists the wear of the traffic very well and that, because of the great re-cementing power of the binder, is fresh, smooth, clean and absolutely free from dust after each rain.

Another method, not however as yet so extensively used as the first, consists in mixing limestone with the feldspathic stone in the aggregate, in addition to the surface sprinkling of the screenings. This has been done by using a mixture of the two different stones in the same sizes, as well as by using smaller sizes of limestone to fill the voids between the larger feldspathic stones, or the reverse. This seems to make, as would appear natural, an even more solid and resistant road. A comparison of the local costs of the two kinds of stone and of the difference in annual repair figures would determine the better method in any particular locality.

The repairs are slight on these glutrin-bound stone surfaces owing to the healing and re-cementing action of the bond. When necessary, however, they are made by cleaning out the hole or depression, putting in new fine stone and dust and sprinkling with glutrin, usually without dilution. This is packed by the traffic and soon cannot be distinguished from the rest of the surface. In this connection it may be noted that although this binder is very dark in color it changes the natural color of the road but slightly and that a few weeks after its application even this slight difference in shade cannot be detected.

The actual length of time before resurfacing is necessary depends on the hardness of the stone used in each case, but it has been found that as compared to the plain water bond, on similar stones, the period is increased by at least 50 per cent. A method of renewal that is giving good results consists in spreading over the center 7 to 9 feet on a 16-foot road, about 20

to 25 tons of limestone or feldspathic screenings and dust, as the aggregate may demand, to each mile. This is then sprinkled with glutrin water and packed by the traffic or rolled. This is done as soon as the road surface shows any signs of general wear, and seems to be a very economical method.

While all these details have been described as on stone roads, it is easy to see that, bearing in mind the close relationship between the rocks and the soils, similar results could be obtained with this binder on clay-gravels and other mixtures, such as sand-clay, etc. Such, indeed, has proved the case, and it has been demonstrated that earth roads of a smoothness and hardness never before supposed possible can be built with glutrin. It is, of course, necessary that they be properly graded and drained and that a careful selection of the soils be made for the mixture.

Methods for Testing Coal Tar and Refined Tars, Oils and Pitches Derived Therefrom

By S. R. Church, Barrett Manufacturing Company, New York City

THE tests described in this article are not put forward as methods for the scientific examination of, or reasearch into, the products of coal tar. An attempt has been made by a committee of chemists of this company to revise and standardize the every-day tests applied to the raw materials and products of the American tar distiller. The primary object of this undertaking was that concordant results might be obtained by the operators in the company's own laboratories. It is well known to those who have engaged in the testing of tar, pitch, creosote oil, etc., that results are absolutely not comparable in most cases unless both analysts have used the same methods. Even then great care is necessary to eliminate the personal element. The foregoing is much more applicable to these physical tests of complex hydrocarbons than it is to strictly chemical analyses, which involve definite reactions and are calculated according to formulae.

It is now over a year since these methods were adopted for use in our laboratories and the results have been encouraging. Many of the tests, particularly those of pitch, refined tar and creosote oil are of interest to the consumer as well as to the producer. In response to many requests from time to time we have furnished copies of certain tests to chemists and engineers who desired them. The melting-point test for pitch may fairly be called standard for designating and testing pitches throughout the country. The tests of creosote oil include the methods of the American Railway Engineering and Maintenance of Way Association, which are widely used by consumers of creosoted materials, and the methods of the United States Department of Agriculture, with slight modifications.

The tests are now described and illustrated in detail, in the belief that it will be a help to some who are called upon to test, or draw specifications for testing, materials concerning which little information is available in textbooks. It is not supposed that the methods are the best possible in every instance. In some cases concessions have been made to precedent, in others to convenience. They will undoubtedly be revised from time to time as valued suggestions come to us from the rapidly increasing number of chemists who are engaging in the examination of these materials.

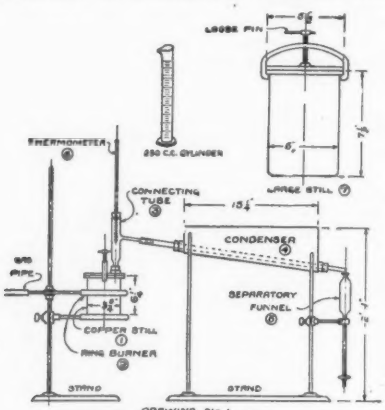
(NOTE—Apparatus marked "Special" or "Standard" on drawings is made up to our order and we will advise any one interested where such apparatus may be obtained.)

TAR.

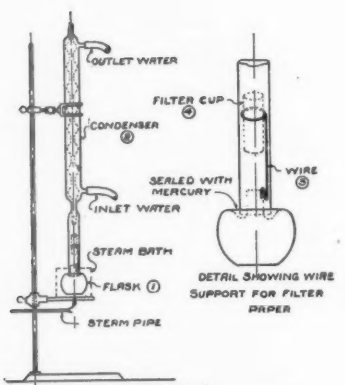
(*a*) *Water in Tar.*

The apparatus used is illustrated in Drawing No. 1. Measure 50 cc. of coal tar naphtha or light oil (which must be tested to determine that it is free from water, whenever a new supply is required) in a 250 cc. measuring cylinder. (No objection is raised to measusing the tar direct into the still or in other ways, but the measurement must be made as described in case of dispute.) Add 200 cc. of the tar. Transfer contents of cylinder to copper still

and wash the cylinder with 50-75 cc. more of naphtha, adding the washings to contents of the still. Attach lid and clamp, using a paper gasket and set up apparatus as shown in drawing No. 1. Apply heat by means of the ring burner and distil until the vapor temperature, as indicated by the thermometer (in this and all other tests care must be used to have thermometer set exactly as shown in drawings) has reached 205 degrees C. (400 degrees F.). The distillate is collected in the separatory funnel, to which 15-20 cc. of benzol has been previously added. This effects a clean separation of the water and oil. The reading is made after twirling the funnel and allowing to settle for a few minutes. The percentage is figured by volume.



DRAWING No. 1.
CRUDE TAR DISTILLATION
No. 1- COPPER STILL, SMALL SIZE SPECIAL
No. 2- RING BURNER " " "
No. 3- CONNECTING TUBE
No. 4- CONDENSER WITH TUBE
No. 5- SEPARATORY FUNNEL
No. 6- THERMOMETER STANDARD
No. 7- LARGE STILL FOR COMPLETE TAR TEST SPECIAL
No. 8- RING BURNER, LARGE SIZE, SPECIAL (NOT SHOWN)



DRAWING No. 2
EXTRACTION APPARATUS FOR FREE CARBON
No. 1- FLASK (E&A 3188A or 3188C
No. 2- KNORR EXTRACTION APPARATUS E&A 3188
No. 3- WIRE, COPPER AS PER SKETCH
No. 4- FILTER CUP, 2 SHEETS C.S. & S 575 PREPARED AS DESCRIBED

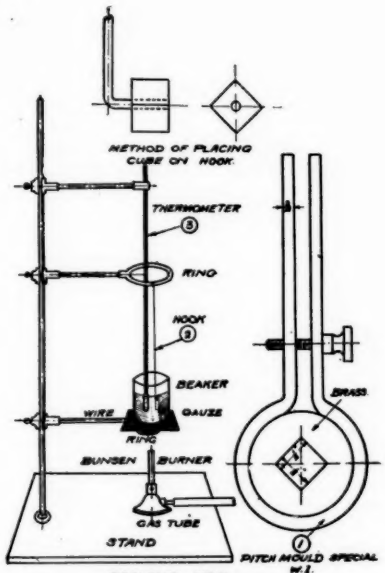
(*b*) *Specific Gravity.*

The tar is dried by taking 300-400 cc. in the apparatus used for water determination without the addition of naphtha. The distillation is carried to 170 degrees C. (338 degrees F.) vapor temperature. Any oil which has distilled over is separated from the water and returned to the still and thoroughly mixed in after cooling. Apparatus: A specific gravity bottle, Hubbard type (special), whose water capacity at 15.5 degrees C. (60 degrees F.) has been determined by experiment. Ten grams of tar are introduced at a temperature of 40-50 degrees into the weighing bottle and the weight taken after cooling. Then freshly boiled distilled water is added and the bottle kept in a bath at 15.5 degrees C. (60 degrees F.) until no further contraction takes place. The water is then adjusted to the mark and the bottle removed from the bath and weighed. Weight of tar divided by the weight of H_2O displaced gives the specific gravity. For rough determination, as of wet tar, a spindle may be used at any convenient temperature. To reduce the gravity as found to 15.5 degrees C., 0.000685 is added for each degree C. above 15.5 degrees C. (or 0.00038 for each degree F. above 60 degrees F.).

(*c*) *Free Carbon.*

Apparatus is shown in Drawing No. 2. Tar dried as under specific gravity must always be used. The dried tar is passed through a 30-mesh sieve to remove any foreign substances. In testing tars of 5 per cent. or more carbon content 5 grams are taken. On lesser percentages 10 grams are used. The amount is weighed out into a 50 cc. beaker and digested with C. P. toluol on the steam bath. Two 15 cm., 575 S. and S. filter papers, the inner one cut to 14 cm. diameter, are folded around a rod of about 1.5 cm. diameter, so as to form a long cylindrical filter cup. (These filter papers have been previously extracted with benzol to render them fat-free.) The cup is dried at 100-110 degrees C. and placed in weighing bottle and weighed after cooling. It is supported by a wire or some convenient method over a beaker. The toluol tar mixture is now decanted through this cup and the beaker washed with hot toluol until clean, all washings being passed through the cup. (A convenient "po-

liceman" to use in cleaning the beaker is a stout chicken feather trimmed so as to have a small fan at the end.) The filtrate should be carefully examined for any particles of free carbon and if there is any evidence of same, should be refiltered. Finally the cup is washed two or three times with hot C. P. benzol and then is transferred to the extraction apparatus (see Figs. 1 and 2), the filter cup being supported by a wire (Fig. 3). C. P. benzol is used as a solvent, heat being applied by a steam bath and the extraction is continued a number of hours until the descending benzol is completely colorless. The cup is then removed, dried as before, and weighed in the bottle after cooling. The balance used for the above determination should be accurate to 0.5 mg. In removing the filter papers from the extractor care should be taken that no particles of mercury find their way into the precipitate. To prevent splashing the filter paper should be elevated as near to the outlet of the condenser as possible. A good precaution is to cover the top of the filter cup with a round cap of filter paper.



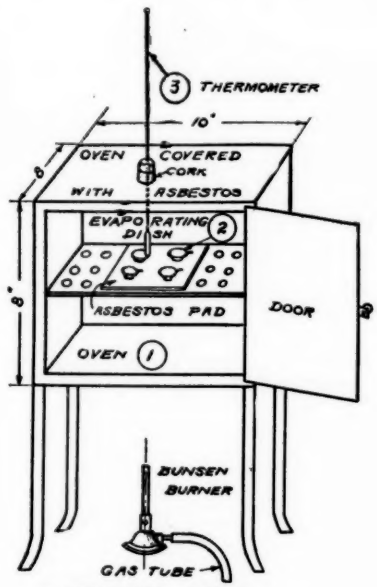
DRAWING Nº 3
MELTING POINT TEST
Nº 1 PITCH MOULD (SPECIAL)
Nº 2 HOOK, MAKE OF #12 COPPER WIRE
Nº 3 THERMOMETER (SPECIAL).

(d) *Fixed Carbon and Ash.*

Fixed Carbon.—Based on report of committee on coal analysis. Place 1 gram of tar in a platinum crucible having a tightly fitting cover. Heat over the full flame of a Bunsen burner for seven minutes by the watch. The crucible should be supported on a platinum triangle with the bottom 6 to 8 cm. above the top of the burner. The flame should be fully 20 cm. high when burning free, and the determination should be made in a place free from drafts. The upper surface should remain covered with carbon. To find "volatile combustible matter" subtract the per cent. of moisture from the loss found here. The residue in the crucible minus the ash represents the coke or fixed carbon.

Previous to applying the full heat of the Bunsen flame for seven minutes, as above described, the tar should be gently heated for a few minutes until the tendency to foam is passed.

Ash.—Take 10 grams in an open platinum or porcelain crucible and incinerate to constant weight by any convenient method, being careful to avoid foaming at the start or carrying off ash at the end.



DRAWING Nº 4.
DRYING & EVAPORATING OVEN.
Nº 1- 8"x8"x15"-DRYING OVEN EJA 3030 ASBESTOS COVERED
Nº 2-DISHES- EJA 2376-2" DIA (SPECIAL)
Nº 3-THERMOMETER - STANDARD.

(e) *Viscosity.*

The Engler viscosimeter is used and time of flow of 200 cc. at 60 degrees C. (140 degrees F.) is taken. All directions for use of viscosimeter accompany the apparatus (E. & A. 7167, p. 393).

DISTILLED TARS.

Saturating Mixtures, Tarvia, Coatings.

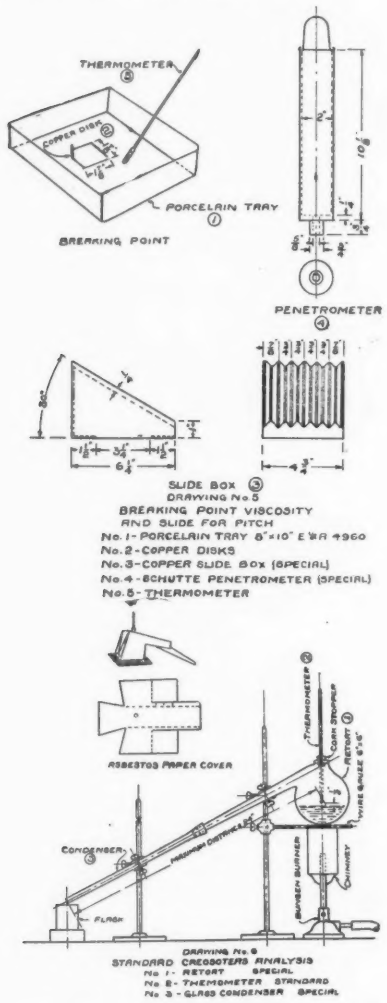
A. Specific Gravity.—(Same as Tar.)

B. Free Carbon.—(Same as Tar.)

C. Viscosity.—

1. Saturating and light tarvias—Engler viscosimeter (same as Tar).

2. Tarvia X to soft pitch—Schutte penetrometer, Drawing No. 5.



[1] The fraction −170° C. shows crude benzol, toluol and solvent; 170–200° crude heavy naphtha.

[2] Distillation continued to dryness and drying point recorded.

The tests on the Schutte penetrometer shall be made as follows:

The plug used shall be of the following dimensions: Diameter, ⅝ of an inch; height, 1 inch.

In filling the plug, it shall be placed upon a flat tin roofing disc, which has been greased with vaseline. The material shall then be poured in and the plug placed in water of the required temperature, for at least ten minutes. The plug shall then be screwed into the tube while the tube is in position, and the plug submerged in the water. The tube shall be filled with water of the given temperature, and the disc removed by slipping it sideways. The time shall be taken from the moment of slipping the disc. Extreme care must be taken to take the temperature accurately and keep the water at the given temperature within ½ of a degree. An accurate thermometer shall be used. The water in the tank shall barely cover the shoulder of the tube. If care is taken to keep accurate temperatures, and the test is made with skill, successive determinations should agree within five seconds.

D. Distillation.—As under standard creosote method (see Creosote).

Temperature and fractions are to be taken as required.

PITCH.

A. Specific Gravity.—On soft pitch this is taken in a bottle as described under Tars. On hard pitch an alternative method is suspension of a lump from the balance beam by a thread and noting the weight in air and water, being careful to remove any air bubbles found on the lump.

B. Free Carbon as in Tars.—

1. Pitches from 43 degrees to 77 de- be ground.

2. The carbon residue should be examined for foreign matter.

C. Melting Point.—Apparatus shown in Fig. 3.

1. Pitches from 43 degrees to 77 degrees C. (100 degrees to 170 degrees F.). A clean-shaped ½-inch cube of the pitch to be formed in the mold, placed on the hook of No. 12 copper wire, and suspended in the 600 cc. beaker so that the bottom of the pitch is 1 inch above the bottom of the beaker. (A sheet of paper placed on bottom of beaker and conveniently weighted will prevent the pitch from sticking to the beaker when it drops off.) The pitch to remain five minutes in 400 cc. of water at a temperature of 15.5 degrees C. before heat is applied. Heat to be applied in such manner that the temperature of the water is raised 5 degrees C. (9 degrees F.) each minute. The temperature recorded by the thermometer at the instant the pitch touches bottom of the beaker to be considered the melting point.

2. Below 43 degrees C. (110 degrees

F.) the same method can be used except that at the start the water should have a temperature of 4 degrees C. (40 degrees F.).

3. For pitches from 77 degrees C. up (170 degrees F.), cotton-seed oil should be substituted for water; otherwise the method remains the same. With these harder pitches, it may be necessary to heat the pitch in order to form a cube. Care should be used not to heat it any higher than is necessary, or to continue heating it for any length of time. A hot knife blade will often assist this manipulation.

(NOTE.—To aid the removal of the pitch from the mold it may be greased with a very thin film of vaseline.)

D. Breaking Point.—Apparatus, Fig. 5, Figs. 1 and 2. A small piece of pitch is quickly melted directly on the copper disc on the steam bath to a layer of about 1-32 of an inch. The disc is then placed in the porcelain dish and well covered with water of about 10 degrees to 12 degrees C. above the breaking point of the pitch. The temperature is reduced 1 degrees per minute and tested from time to time by inserting a small, thin knife blade below the pitch and turning slightly until a point is reached at which the pitch snaps. This is taken as the breaking point. The copper disc should be held with a pair of tongs and not with the fingers.

E. Evaporation Test.—Apparatus as shown in *Drawing No. 4.* The oven should have the top and sides covered with ⅛-inch asbestos. The shelf is provided with a ¼-inch asbestos pad, large enough to accommodate the dishes. The bulb of the thermometer should be 1 inch above the shelf and the emergent stem must be within 10 degrees C. of 100 degrees. Not more than 4 tests should be run in oven at a time. Ten grams of pitch are weighed in the dish, placed in the oven and held exactly at 160 degrees C. for seven hours and after cooling in a desiccator, the loss in weight is noted.

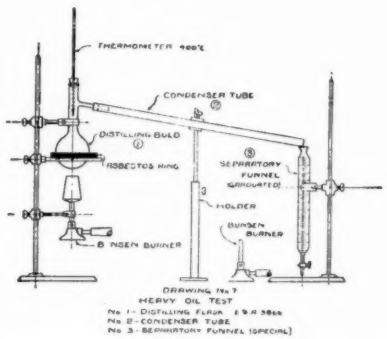
When accuracy is required the apparatus used shall be a circular oven of the type described in Eimer & Amend's catalog No. 2073 D, having double walls, circulating fan and self-contained burner.

F. Slide Test.—Apparatus as in Drawing No. 5, Fig. 3. A ½-inch cube of pitch, such as used for the melting point, is placed at the top of a depression in the corrugated plate (angle 30 degrees) and warmed slightly and pressed down so as to present a rounded top, care being taken to keep the front edge intact. A mark is made on the adjoining ridge parallel to the front edge of the cube. The slide plate is placed in an oven with a thermometer about 1 inch above the center of the slide and kept at 40 degrees C. for seven hours. The measurement it taken from the previous mark to the furthest point the pitch has reached.

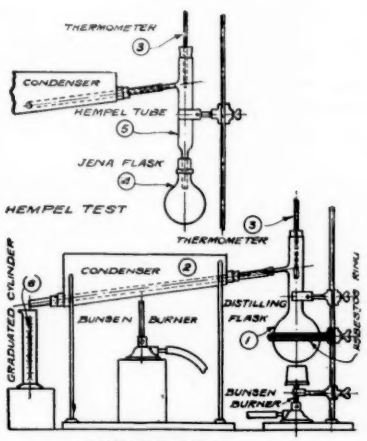
(NOTE.—Soft pitches which run beyond end of slide must be watched and the time they slide to the end noted.)

G. Fixed carbon as in tar.

H. Ash as in tar.



DRAWING No. 7
HEAVY OIL TEST
No. 1 - DISTILLING FLASK
No. 2 - CONDENSER TUBE
No. 3 - SEPARATORY FUNNEL (SPECIAL)



— DRAWING No. 8. —
LIGHT OIL DISTILLATION
No. 1 - DISTILLING FLASK (E & A - 3946).
No. 2 - CONDENSER (SPECIAL)
No. 3 - THERMOMETER (STANDARD)
No. 4 - JENA FLASK (A. H. THOMAS - 4256, 200 CC)
No. 5 - HEMPEL TUBE (SPECIAL)
No. 6 - GRADUATED CYLINDER (100 CC)

LIGHT OIL.

A. Specific Gravity.—Taken with a hydrometer at 15.5 degrees C. For this and subsequent tests it must be dried if containing more than 1 per cent. of water. This is done as described under creosote.

B. Distillation.—Apparatus as in Drawing No. 8. 100 cc. are measured in a cylinder and transferred to the 200 cc. Jena glass distilling bulb and heated. The distillate is collected in a 100 cc. cylinder. The point where the first drop falls from the end of the condenser is noted and thereafter the cc. distilled noted at every even 10 degrees C. continuing until 95 per cent. of the oil has distilled. Toward the end, the condensing water must be heated to avoid separation of napthaline.

C. Tar Acids.—The distillate from B is taken in the separatory funnel (Drawing 7, Fig. 3) as used in creosote oil and the tar acids determined in the same way.

D. Redistillation.—The extracted oil is placed in the Hempel apparatus (Drawing 8, Figs. 4 and 5) and redistilled, noting the cc. that have come over at 170 degrees C., at which latter point the distillation is interrupted.

E. Naphthalene.—The residue above 200 degrees left in the flask in D is transferred to a copper breaker and cooled to 15.5 degrees C. for fifteen minutes and the dry napthalene determined as under creosote.

CARBOLIC ACID.

A. Specific Gravity.—Apparatus—see Drawing 8. If the oil is not limpid at 15.5 degrees C., the gravity is taken at a higher temperature and 0.0008 added to the specifis gravity for every degree above 15.5 degrees.

B. Distillation—same as "Light Oil."

C. Tar Acids—same as "Light Oil."

BENZOLS.

A. Distillation.—Apparatus—see Drawing 8. Same as light oil, with the water in the condenser always cold. With C. P. benzol or toluol readings are taken every 0.2 degrees C.; with commercial benzols every 10 degrees C. a reading is taken.

B. Gravity.—Hydrometer at 15.5 degrees C.

C. Wash Test.—Taken only on water white grades.

About 7 cc. of concentrated H_2SO_4 and 21 cc. of the benzol are shaken in a small glass stoppered French square bottle of 30 cc. capacity and the coloration of the acid and oil noted.

CREOSOTE OILS.

A. Standard Creosoters Distillation.—Apparatus. Drawing 6. Method as given in *Bull.* 65, American Railway Engineering and Maintenance of Way Association.

Before beginning the distillation, the retort should be carefully weighed and exactly 100 grams of the oil placed therein, the same being weighed in the retort. The thermometer should be inserted in the retort with the lower end of the bulb ½-inch from the surface of the oil, and the condensing tube attached to the retort by a tight cork joint. The distance between the bulb of the thermometer and the end of the condensing tube should not be less than 20 nor more than 24 inches, and during the progress of the distillation the thermometer must remain in the position originally placed.

The distillates should be collected in weighed bottles and all fractions determined by weight. Reports are to be made on the following fractions:

0 to 170 degrees Centigrade
170 to 200 degrees Centigrade
200 to 210 degrees Centigrade
210 to 235 degrees Centigrade
235 to 270 degrees Centigrade
270 to 315 degrees Centigrade
315 to 355 degrees Centigrade

For practical purposes there will be no need of reporting on all of these fractions. It will be sufficient to report on the fractions as follows:

Below 200 degrees Centigrade
200 to 210 degrees Centigrade
210 to 235 degrees Centigrade
235 to 315 degrees Centigrade
Above 315 degrees Centigrade

Reports to be made on individual fractions. In making such reports, it is to be disinctly understood that these fractions do not necessarily refer to individual compounds. In other words, the fractions between 210 and 235 degrees will not necessarily be all napthalene, but will probably contain a number of other compounds.

The distillation should be a continuous one and should take about forty-five minutes.

When any measurable quantity of water is present in the oil, the distillation should be stopped, the oil separated from the water, and returned to the retort, when the distillation should be recommenced, and the previous readings discarded.

In obtaining water-free oil, it will be desirable to free about 300 to 600 cc. of the oil by using the copper tar still and using 100 grams of the water-free oil for the final distillation. In the final report as to fractions, a correction must be made for the water content, so that the report may be made on the basis of a dry oil.

Determination of Specific Gravity of Oil.

In order to determine the specific gravity of any oil, heat the oil in a water bath until it is completely liquid. A glass stirring rod dipped into the liquid should show no solid particle on the rod when the same is withdrawn from the oil. When completely liquid, stir thoroughly and fill the hydrometer cylinder, which has previously been warmed. Insert a specific gravity hydrometer, taking care that the hydrometer does not touch the sides or bottom of the cylinder when the reading is taken. Take the temperature of the oil and make a correction for the specific gravity by reducing the same to the standard temperature of 15.5 degrees C. or 60 degrees F. The correct gravity is obtained by multiplying the correction figure 0.0008 by the number of degrees C., or 0.00044 by the number of degrees F., the oil is found to be above 15.5 degrees C., or 60 degrees F., and adding the product to the observed gravity.

Notes.

1. Emphasis is laid on attention to details and importance of a retort of the standard size.
2. The thermometer used must be of standard make, gas-filled and must be regularly tested for accuracy.

CREOSOTE OIL—ADDITIONAL TESTS.

A. Drying Oil.—Apparatus as in drying tar. 500 cc. are distilled up to 170 degrees C., the water noted and the oil distilling over returned to the still after cooling.

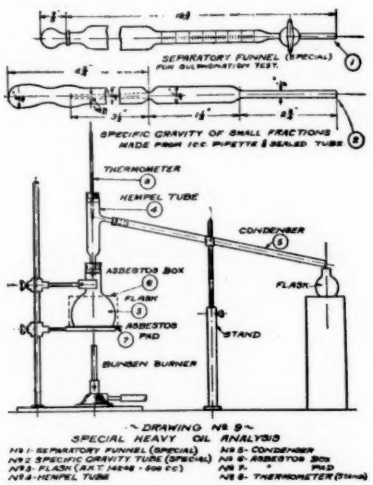
B. Tar Acids—Apparatus shown in Drawing 7. 100 cc. of oil measured at limpid point, placed in Jena glass bulb and distilled. The distillation is continued until at least 95 per cent. has distilled off. The time from the first drop to the end should occupy about twenty minutes. The condenser tube should be kept warm enough by a flame during the operation to prevent distillate from solidifying. Warm the contents of the separatory funnel to 60 degrees C. in water, and note reading. Add 50 cc. of a 10 per cent. caustic soda solution. Shake well and allow to settle, drawing off the clear soda, warming again to 60 degrees, and noting the shrinkage. Repeat, if necessary, until no further shrinkage is noted. Then the total shrinkage is the per cent. of tar acids in the heavy oil.

C. Dry Naphthalene.—The extracted oil from B is placed in a copper beaker and held at 15.5 degrees C., for fifteen minutes. The mass is filtered on a perforated funnel in a suction pump and sucked dry. The napthalene in the filter is then pressed between paper in a letter press to remove all oil and weighed. The percentage is figured on the weights of the original oil as given by the gravity at the limpid point.

D. Limpid Point.—About 5 cc. taken in a No. 4 or No. 5 test tube at 60 degrees C. are cooled, stirring with a thermometer until the first crystals begin to form. This point is taken as the limpid point. Cool in water only, if necessary.

CREOSOTE OIL—SPECIAL TESTS.

A. Distillation as in Circular 112, U. S. Department of Agriculture, except that instead of the Hempel flask as described there, a 500 cc. Jena flask with a Hempel tube (shown in Fig. 3, Drawing 9) attached is used.



DRAWING No. 9
SPECIAL HEAVY OIL ANALYSIS

B. Gravities.—(Apparatus, Fig. 2, Drawing 9.) This is standardized with the pipette filled with water at 60 degrees C. Oil at 60 degrees is drawn up to the mark in the pipette, replaced in the outer tube and weighed. This can be used when only one or two cc. of oil are available.

C. Sulphonation Test.—Apparatus, Drawing 9. The weighed fraction distilling between 305 degrees and 20 degrees C. is warmed with concentrated H_2SO_4 (About 4-5 volumes) to 60 degrees C. and the whole transferred to the separatory funnel (Fig. 1). The flask is rinsed three times with more H_2SO_4 and the rinsings added to the funnel. Then the funnel is stoppered and shaken, cautiously at first; afterwards

vigorously, for about fifteen minutes. Then let settle over night. Then the acid is carefully drawn down into the graduated portion to within 2 cc. of where unsulphonated residue shows. Whether any is visible or not the test should be carried further as follows: Add about 20 cc. water and let settle for one-half hour. Then draw down water as close as possible without drawing out any supernatant oil or emulsion. Then add 10 cc. strong H_2SO_4 and let settle for fifteen to twenty minutes. Any unsulphonated residue will now settle out clear and give a distinct reading. If under 0.2 cc. it should be drawn down into the narrow part just above the stopcock where it can be estimated to 0.01 cc. The cc. are figured as percentages on the weight of the fraction taken.

If the unsulphonated oil is dark in color it should be treated with an excess of 10 per cent. sodium hydroxide solution. If the oil is soluble in this reagent, the test is regarded as negative.—*The Journal of Industrial and Engineering Chemistry.*

OHIO STATE HIGHWAYS.

View of East Avenue Road, Tuscarawas County.

EDITORIAL COMMENT

The Effect of Public Service Commissions Upon Securities of Companies Operating Thereunder

THE EFFECT OF PUBLIC SERVICE COMMISSIONS UPON SECURITIES OF COMPANIES OPERATING THEREUNDER.

What is the effect of the public service commission upon the securities of the companies operating thereunder is a question which has often been asked, and the answer has not yet been given definitely.

Massachusetts has had a gas and electric light commission for many years, and that commission has had close oversight of the operations of companies. Rates have not been unduly reduced, indeed, the reductions in cost of operation, particularly in the cost of producing electricity (as shown in one of the leading articles on a preceding page) have been so extensive that rates could be materially reduced and at the same time the net returns from operation could remain large. In fact, as stated in the article referred to, the returns on the capital have been but slightly reduced in the past twenty years and securities have reached the stability of municipal bonds, so that the offerings of stock and bonds are readily taken at the prices fixed by the commission, which are regularly at or above par. So far as Massachusetts is concerned, therefore, the answer to the question seems to be that values are steadier, speculative elements are removed, capital is more willing to offer itself and at lower net rates than formerly, because of the greater safety both as concerns the value of the investment, the adjustment of the income to the demands of the plant operation, through proper application to the commission for change of rates, and the knowledge that the relation of capital to possibilities of profit will not be objectionably affected by unauthorized or ill-advised issue of stocks or bonds, since these issues must be approved by the commission.

The condition in Wisconsin is somewhat different. There the companies have had the privilege of continuing operation under their charters as they existed before the public service commission law was passed, or of giving up those charters and accepting an indeterminate permit under the supervision of the State.

One of the early questions was as to the meaning of the term "indeterminate permit." Since it has been shown that this really means a perpetual franchise, or a purchase by the municipality at a valuation which takes into account all the conditions and insures a return to the capitalist equivalent to that which he gets from the operation of the plant, the terrors, simulated or real, which the words inspired have been allayed, and a large proportion of the public service corporations in the State have elected to serve under the commission and its indeterminate permit. So far as observation goes, therefore, the indications are that the public service commission law has had a beneficial effect upon the securities of companies operating thereunder. There is no means of measuring accurately this effect, but those who are studying the problem state that the securities of the corporations operating under the indeterminate permit of the Railroad Commission of Wisconsin are somewhat at a premium as compared with the securities of other corporations in the State, which are operating under the old franchises. The reason given for this effect is that any one familiar with the indeterminate permit would naturally prefer the securities of a company operating under it, since he would consider the security better for the reasons that the corporation can

never be deprived of its property, except upon a fair value paid by the municipality when taking it over; that the depressing effect of contests over terms and conditions of franchises is completely eliminated; that securities can not be issued in excess of what the plant is actually worth; that the company is obliged to maintain the plant in efficient operating condition; that a depreciation reserve fund must be maintained so that replacements can be made out of operating revenues. These are certainly strong reasons for approval of the law, and they demonstrate the correctness of the position which capital seeking legitimate investments seems to have taken.

The confidence of the investing public in the salutary effects of the indeterminate permits and the control by the state commission of certain features of the operations of the companies accepting them will be strengthened by a recent decision of the Wisconsin Supreme Court in the case of the city of LaCrosse vs. the LaCrosse Gas and Electric Co.

Under the terms of the franchise granted the company by the city, the company was required to pay to the city 2 per cent. of its gross earnings in addition to other legal taxes. The company elected to give up this franchise and to operate under an indeterminate permit issued by the Railroad Commission of Wisconsin. Thereafter it failed to make to the city its report of earnings and to make the payment, and the city sued to recover, except as to a part of the first year of its operation under the new conditions, for which it paid under protest the 2 per cent. for the part of the year after it had received its indeterminate permit.

The opinion of the court demonstrates that such a feature in a franchise for a public service corporation inheres therein and is subject to the reserved power of the State under the constitution to alter or amend. The question whether operation of the company under the indeterminate permit is burdened by the requirement to pay 2 per cent. of gross earnings to the city is argued at some length in the light of previous practice concerning franchise provisions, whereby some of them were prescribed by the State and some by the city served; and in the light of the purpose of the statute establishing the public service commission duties of the Railroad Commission to substitute new direct grants from the State of a uniform character, free from the peculiarities of the old franchises, for the complicated and varied provisions of the latter.

The opinion gives high praise to the legislature for its method of dealing with the matter, stating that

> The result stands significant as a monument to legislative wisdom. That such a complicated situation has been met by written law in such a way as to avoid successful attack up to this time on the validity of the law or any part of it, and avoid attack at all either upon the law or its administration, except in a very few instances, and secure optional submission by many owners of old franchises to a displacement of their privileges, is quite a marvel, reflecting credit upon the law-making power and the body charged with the onerous duty of administering the statute, and challenging judicial attention to the importance of not by construction reading out of the enactment any meaning not clearly found there—even to avoid a seemingly unlooked for disturbing consequence in a particular instance now and then—which would tend to defeat the object of the law.

The opinion, therefore, proceeds as follows:

> The foregoing analysis of the public utility law seems to demonstrate that retention of the special feature of the surrendered franchise in question as a feature of the new one, differentiating it from indeterminate permits in general, affording the city, really at the expense of consumers, the benefit of 2 per cent. of respondent's gross earnings, is plainly inconsistent with "the terms, conditions and limitations" of the public utility law which, as we have seen, it is declared over and over again therein shall characterize every indeterminate permit, whether

an original grant or a privilege given for an old franchise.

The protection of the public service commission law is thus made uniform for all public service corporations desiring it, and the stability of the structure which has been built so rapidly and so well within the past few years is thus greatly enhanced.

Those who are interested in the promotion of new public service industries and in the exploitation of those already in operation are not so well pleased with the law. In the words of one of them, "The promoters must now steer clear of Wisconsin." Happy Wisconsin! Most of the troubles with public service corporations have arisen from the sense of injustice which has been aroused in the minds of consumers of their products by imperfect knowledge of the manipulations of such promoters, their undue profits in some instances, their wrecking of properties in others, their undue influences upon municipal legislators in others. If the Wisconsin law has done nothing but force these men to steer clear of the State it has fully justified itself and all the expense of its operation.

Cities in other States not favored by such laws have been trying to secure like results by means of more or less close approximations to the practice of the Wisconsin commission, always far different, because of the extreme difficulty of establishing for a single city an independent, unimpeachable, competent expert body such as the State Commission of Wisconsin has proved itself to be. An arbitration on such lines is now in progress in one city and the results will be published later. Even if one such board happens to come into existence, the hand of the interested party gets into the municipal elections in time for the next question brought up for settlement and the people have the whole fight to go through again with the probability that they have on the other side, not only the public service corporation, but the city's own representatives. Pending the establishment of a state commission, there seems at present to be nothing else to do.

THE QUESTION DEPARTMENT

Cities Operating Garbage Incinerators.

Kindly give me the names of a few cities that successfully operated incinerators. I wish to look into the methods of operation, etc. B., ————, Pa.

The fullest list of incinerator plants is the chronological list in Morse's "The Collection and Disposal of Municipal Wsate" ($5). extending down to and including plants built in 1908.

Among those not included in the list are the following: The Decarie plants in Rankin, Pa., Richmond, Va., Portsmouth, Va., Lynchburg, Va., Wheeling, W. Va., E. Liverpool, O.; the Thompson plants in Houston and Austin, Tex.; the Dixon plant at Uniontown, Pa.; the Public Works Engineering Co. plants at El Paso, Tex.; Portland, Ore.; and Vancouver, B. C.; the Lewis and Kitchen plants at Terre Haute, Ind., and Topeka, Kan.; the Heenan-Froude plants at Milwaukee, Wis., and Montgomery, Ala.; the Morse-Boulger plant at Easton, Pa.

Cleaning Streets by Flushing.

In your issue of October, 1910, page 316, there is an article by J. W. Howard concerning the use of a flushing machine on pavements, in which he refers to a paper prepared by John Hittell of Chicago in 1907. I would like to know if you printed this paper in any edition of your magazine. Also I would appreciate any references to other articles in relation to the damage caused by street flushing machines which have appeared in your various editions.
F. L. J., Chicago, Ill.

The paper referred to is by John B. Hittell, chief engineer of streets, Chicago, Ill., and is entitled "Guarantee Clause in Paving Specifications." It was printed in full in the volume of proceedings of the American Society of Municipal Improvements for 1907. It is printed almost in full in

MUNICIPAL ENGINEERING, vol. xxxiii, p. 331. It makes no particular reference to street flushing, being confined to the ground covered by its title.

Information concerning street flushing and other methods of street cleaning can be obtained from the following additional articles in MUNICIPAL ENGINEERING:

In vol xl: "Cost and Efficiency of Street Cleaning Methods," p. 32; "Flushing Streets Under High Pressure," p. 132; "Flushing Streets With Water Under Pressure," p. 132; "A Motor-Propelled Sweeping and Flushing Machine, p. 372.

In vol. xxxix: "Street Cleaning by Vacuum Process," p. 115; "A High Pressure Street Flusher," p. 154; the above named "Flushing Pavements With Water Under High Pressure," p. 316; "Flushing Streets Under High Pressure," p. 393.

In vol. xxviii: "Methods and Cost of Street Cleaning and Sprinkling," p. 193, which gives a number of references to earlier articles on the subject; "Cost of Street Cleaning," p. 340.

In vol. xxxvi: "A New Sanitary Street Washing Machine," p. 333; "Street Cleaning in Detroit,' p. 383, giving experience with various methods, including flushing, in that city; "The Squeegee Street Washer," p. 399.

In vol. xxxv: "Information on Street Cleaning and Garbage Collection and Disposal," p. 179, giving a list of earlier articles.

In vol. xxxiv: "Street Cleaning," p. 184; " A Street Cleaning Automobile," p. 266; "Methods and Cost of Street Cleaning," p. 299, giving references to some earlier articles.

In vol. xviii: "Flushing With Water as a Means of Cleaning Paved Streets," p. 249.

Most of these articles can be supplied at 25 cents each.

Manufacturers of Garbage Disposal Plants.

The board of public works is considering the installation of a garbage disposal plant to take the place of the present unsatisfactory method of garbage disposal by dumping. Will you kindly put us in communication with any persons or firms who might be interested in this proposition? L., ————, Ky.

Reference should be made to the "Business Directory" printed in each number of MUNICIPAL ENGINEERING under the headings "Garbage Disposal Plants," "Refuse Destructors," "Destructors."

Books on Sewers and Tunneling.

I am looking for the latest book on sewer construction. I want a book that will tell the best methods of tunneilng through earth in sewer construction.

H., Rochester, Ind.

The latest book on sewerage is Watson's "Sewerage Systems" ($4). It is the only book on this subject which covers the subject of tunneling for sewers, and it has ten pages giving brief and clear statements of the best methods. Folwell's "Sewerage" ($3) recently appeared in a new edition, but it contains very little on tunneling. Prelini's "Tunneling" ($3) or Stauffer's "Modern Tunnel Practice," ($3.50) may be consulted and some of the methods therein described may be applied to tunneling for sewers.

Value of Waterworks Franchise.

Did you not publish a decision relative to the value of a franchise in a water works case in the matter of appraisal of a franchise therein?

S. C. S., Waverly, N. Y.

The only decision of this nature published recently is that in the case of the Spring Valley Water Co., vs. the City and County of San Francisco, reported in 165 *Federal Reporter*, p. 667, and noted in MUNICIPAL ENGINEERING, vol. xxxvii, p. 44. This was a note from the syllabus of the case to the effect that a franchise has value which should be taken into account in determining the return allowable upon the value of the property when determining rates. That this value may be small is indicated by the following abstract from that portion of the opinion named concerning the value of the franchise as a part of the property of the company:

If when the franchise was acquired, or at any subsequent time, the city entered into a contract with the company providing for definite rates of income, and this agreement is now binding, and gives a present value to the franchise; or if for a number of years the aggregate market value of the stock and bonds of the company has exceeded the actual value of the physical plant; or if, as in the Consolidated Gas Co. v. New York, the franchise was capitalized for some fixed sum, it would be very easy to determine whether the franchise has value, and what that value is. But here it does not appear that the franchise is defined by any specific contract with the city; neither is it an exclusive franchise; and it is not shown that the market value of the stocks and bonds ever exceeded the value of the physical property. The water company's system probably has a value as a whole which exceeds the sum of the values of its several physical elements and characteristics. That value is affected by the franchise, by the fact that the concern is a going business. If the franchise and going business have ever had a distinct, independent, productive value, it should appear somewhere or at some time in an exhibition of distinct earning power.

The opinion also states that there is no authority for imputing to a franchise a value which did not accrue to it by the original terms of the franchise. Also, that the fact of assessment of the franchise value for taxation was not conclusive evidence of the value of the franchise.

Following are other articles in MUNICIPAL ENGINEERING with information on the same subject: Cases of no franchise value are reported in vol. xxxix, p. 45, regarding Carthage, Mo., and p. 300, regarding Oma-

ha, Neb. Franchise provisions quoted in an article on p. 400 show no value allowed in Taylorville, Ill., and 10 per cent. of the cost of duplicating plant allowed in Mexico, Mo., for earning power, franchise value, going value and contingencies, which would leave little or nothing for franchise value, if reasonable allowances are made for the other items.

In vol. xxxviii, an allowance is shown in valuing the Richmond, Ind., water works of one-sixth for going concern value, which may or may not be considered to include the other items named in the Mexico, Mo., franchise.

There is a good article in vol. xxxvi, p. 247, on water works franchise covering this question and allowing no franchise value in determining rates for water. Other articles of similar nature and referring to special cases will be found in vol. xxxiv, pp. 28 and 296, and vol. xxxi, p. 135.

Several articles on the general subject of municipal franchises, discussing value incidentally, will be found in vol. xxix, pp. 340, 345, 353, 359, 442. Some brief notes will be found in vol. xxv, pp. 40 and 98, which will be of interest. Some data on taxing franchises will be found in vol. xxiv, pp. 41 and 42 and on the Omaha case, allowing no franchise value on p. 202.

A discussion of franchise values, giving some figures will be found in vol. xxiii, p. 248. A good general article is given on p. 337.

The Chicago street railway case, allowing no franchise value, but allowing compensation for compulsory sale, is considered in detail in vol. xxii, p. 34.

Some figures on values of water works franchises and references to authorities are given in vol. xvii, p. 146. The basis of the valuation of the Gloucester, Mass., water works, allowing no franchise value, but giving a going value, is given on p. 169.

There is a full discussion, with practical examples of the value of water works, particularly franchises, in an article in vol. xvi, p. 380. A valuation of the Indianapolis water works is given in vol. xv, p. 253, but does not include value of franchise.

Apparatus for Finding Leaks in Water Pipes.

Could you inform us of an instrument for detecting leaks in water mains and pipes, and where it could be purchased?

S., ————, N. Y.

The instruments for detecting flow of water in pipes by sound can be used to some extent in detecting leakage. They are of different degrees of elaboration up from a simple rod which can be put in contact with the pipe or valve and will transmit the sound of flowing water to the ear held at the other end. A common audiphone can be put in contact with the end of the rod to magnify the sound if desired. The real work of finding the leaks is more difficult than that of detecting the flow of water in the pipe. It will be found described in considerable detail in MUNICIPAL ENGINEERING, vol. xxxvi, p. 319. Further information will be found in vol. xxxvii, p. 329. Reference is made in the latter to Rodda's "Waste Water Detector," which is made in England and can probably be purchased of dealers in engineers' instruments. The Deacon instrument is another English piece of apparatus. Reference may be made to the "Business Directory," published in each number of MUNICIPAL ENGINEERING, under the headings "Engineering Instruments," "Surveyors' Instruments," "Testing Machinery" and some of those under "Water Works Supplies and Equipment," for names of those who can either supply the detectors named or can make them of designs equally serviceable. The pipe locater made by the Modern Iron Works, Quincy, Ill., may be found useful also.

What Is Westrumite?

Through your Question Department will you please give me some information regarding Westrumite pavement? I would like details regarding cost, durability, slipperiness, etc., etc., its composition and how it is generally received in the Eastern cities as a pavement.

M. B. G., Roseburg, Oregon.

Westrumite of the present day is very different from the material and process presented under that name perhaps eight or ten years ago. That was a process of applying an oil emulsion to roads already built, or of placing the wearing surface and later treating that surface, and was really one of the early varieties of bituminous or oil macadam produced by the so-called penetration process. This process was abandoned after a very few years as not available for city streets and it was in advance of the demand for such treatment of country roads, which is now becoming insistent.

The inventor then turned his attention to the construction of a pavement which is practically the same in all apparent features as an asphalt pavement, with less slipperiness perhaps, and somewhat less expense. The writer was very favorably impressed with one of the earliest of these streets, which he saw some four years or more ago. The asphaltic material is so prepared that it can be mixed cold by hand or in a concrete mixer with the broken stone, sand, and stone dust forming the aggregate, and the mixture rolled or tamped into place as the wearing surface of a pavement, using an old macadam, broken stone or concrete as the foundation. The character of the foundation to be chosen depends upon the nature of the traffic to be carried.

Westrumite asphalt pavement is preferably laid on a concrete foundation, and

Westrumite asphalt macadam is a lighter construction using the same materials.

The cost of the pavement depends so much upon the local cost of materials that definite figures for any locality can not be given by one not familiar with conditions. It may be said in general that the cost of the Westrumite asphalt pavement will be less than that of standard asphalt and that Westrumite macadam will compare with other bituminous macadams.

The pavement has been used in the beginning in suburban cities around Chicago, the inventor desiring to prove it out thoroughly before extending its use generally. Reports of municipal officials in East Chicago, and Hammond, Ind., state that the pavements are very satisfactory, and the same reports come from streets laid in Brantford, Ont. The sphere of activity is extending into neighboring states and new factories are being built as new centers.

Wood Block Paving Along Street Railway.

In continuation of my questions considered on p. 216 of the March number of MUNICIPAL ENGINEERING will you please give me some information on the following points?

How is a water tight joint made along the rail?

Is there any kind of drainage constructed to take care of the water along the rail? W., ————, Wis.

The making of a water tight joint between pavement and rail that will retain its water-tight quality is difficult, owing to the constant motion under climatic conditions and the action of traffic on both rail and pavement. An adhesive filler, tar or asphalt, is desirable, and one which will retain its ductility and adhesiveness under the changes in temperature to which it is subject. In a northern climate it is difficult to attain this result without making the bituminous mixture so soft that in hot summer weather it will flow away from its place into any open space in pavement or foundation due to defective construction or to loosening up of the same under the shocks of traffic. It is not so difficult to make the water tight joint. The difficulty is rather to keep it tight.

With streets of good gradients water will run down the street car tracks to points where reduction in velocity causes it to overflow the rails and find its way to the gutters. These points will be the only points where special trouble from lack of draining will occur. On a flat street where the drainage was forced by means of alternate ridges and hollows, noticeable on the street only when water was running, the writer has put at the bottom of each hollow a small collector in the middle of each track with a small grating on the surface of the street so that the water collecting there between the rails would drain through the collector into the sewer below. The space between tracks is so crowned that water from it runs over the rail into the channel made by the flange of the rail and runs thence to the low spot as described.

Will our readers report their experience in regard to both the problems presented?

Books on Reinforced Concrete Trestles for Railroads.

Will you advise me where I may obtain model plans and specifications for reinforced concrete trestles for railroads?

B., Carrollton, Ky.

Tyrrell's "Concrete Bridges and Culverts" ($3) contains several trestle designs and tables for designing them. The Atlas Portland Cement Co. publishes a booklet on "Concrete in Railroad Construction," which contains specifications and several designs for railroad trestles.

Tests for Asphalt for Standard Municipal Specifications.

At the recent convention of the American Society of Municipal Improvements at Erie, Pa., a report of which has recently been issued, they adopted a set of specifications for asphalt paving. In these specifications appears a clause which states that the tests called for in these specifications must be made according to the standard requirements on file in the office of the city engineer. I am writing to ask if this clause refers to any particular method of making these tests, and I infer that it does. If such is the case, I will be glad if you will advise me where and how I may obtain a description of the method of making the tests referred to. If no special method was referred to, can you advise me where a description of such tests as are called for can be had.

N., City Engineer, ————, Ala.

This provision was copied from the specifications adopted in 1910 by the Organization of City Officials for Standardizing Paving Specifications, and is understood to refer to no definite method of making tests. Indeed, in the report of the committee on asphalt to the meeting of the same organization held in New York in January, it is said that "the committee, in presenting its standard specifications realized the fact that many of the provisions were dependent on a definite method of test, and cognizance was taken of this fact by the insertion of the clause 'all tests herein provided for must be conducted according to official methods on file in the office of (proper official)'. However, it is suggested that all methods for making tests be defined as soon as possible and, doubtless, many of them can be defined at this meeting. But for those methods that cannot be definitely defined at present, there should be a working committee appointed to investigate methods of tests and also to work out new tests for asphalt. But for such tests as ductility, it is imperative to adopt a definite method at once; otherwise it is impossible to set satisfactorily a definite requirement for that test. Unless this committee completes its labors as to standard tests, it is sug-

gested that cities have their testing laboratories add to these specifications whatever methods of tests that have been standardized locally."

In accordance with this recommendation the committee worked out the formulation of a number of tests during the January convention, which were adopted and have been printed in the volume of proceedings of the convention, which can be procured of John B. Hittell, secretary, City Hall, Chicago, Ill., for $5.

On another page of this number will be found the recommendations of Dow and Smith, asphalt chemists, concerning such tests.

Book on Cement.

I have been informed by one of the engineers of this city that you published a book on cement sometime ago, which contained information relative to the ingredients of slag, Portland and other cements. I represent the city engineer of the city in litigation relative to the paving of one of our city streets and am very desirous of obtaining information of any and all kinds upon the different grades, manufacturing processes, etc., of cement.

J., ————, O.

The "Hand Book for Cement Users" ($3) is the book desired and contains full information on the composition and characteristics of all classes of cement as well as specifications for cement and its uses.

Forms for Improvement Resolutions in Texas.

Have you any briefs on the acts of the Thirty-first Legislature and called session, page 402 and chapter 14? If so, I would like to have some and would like to have forms for ordinances and resolutions covering the proceedings from first step to last. S., City Attorney, ———, Tex.

Will our Texas readers be kind enough to send us the forms they use and copies of ordinances providing for public improvements for publication for the benefit of this aand other correspondents?

Machinery for Making Cement Tiles.

We have been referred to you for information regarding machinery for the manufacture of cement tiles for the purpose of conveying water from reservoirs to plats of ground to be irrigated. Tiles would want to be six to eight inches in size.

Any reliable data that you can give us as to cost and general feasibility of this tile for this purpose will be appreciated.

G. R., Kansas City, Mo.

There is much difference in the quality of work done by different machines, and the question of workmanship is one of the utmost importance with either machines or molds. With good materials and workmanship cement tiles are entirely satisfactory. The comparison of cost with other tiles must be made on the basis of local prices and a general statement might be quite different from the facts in a particular locality.

Reference may be made to the "Business Directory" published in each number of MUNICIPAL ENGINEERING, under the headings "Tile Molds," "Culvert Forms," "Drain Tile Machines," "Irrigation Machinery," "Sewer Pipe Molds" for names of dealers in reliable machinery for making tile by which the best of work can be done.

Who Sells Natural Red Chalk or Ruddle?

I am still looking for information in regard to where I can get a good quality of *natural product* "red chalk" or "ruddle." My question was published in MUNICIPAL ENGINEERING of February, 1910, on page 113.

Perhaps it may be a good plan to give your readers another reminder and see if we can find some one who knows. I understand that both Wisconsin and Michigan produce the mineral, also that the material, and of a good quality, is found in large quantities in the State of Virginia.

L. C. H., Bellingham, Wash.

Perhaps some of our readers know this material as "keel." Is there any of it on the market?

Cities Having Commission Form of Government.

Would you be so kind as to furnish me with a list of the cities in the United States and Dominion of Canada that are governed by commissioners or by Boards of Control, and any suggestions which you might have in reference to this system of government, whether it is considered ahead of the old system of Aldermen and Councillors governing the cities?

F. J. GRIFFITH,
Secretary-Treasurer, Sherbrooke, Que.

Following is a recent list of the cities having the commission form of government. There are probably some additions to make to this list, particularly in Illinois, where elections are being held to dedetermine whether the cities shall join the list of cities governed by commission:

Alabama: Birmingham.

California: Berkeley, Modesto, Oakland, Riverside.

Colorado: Colorado Springs, Grand Junction.

Idaho: Boise, Lewiston.

Illinois: Moline, Rock Island, Springfield.

Iowa: Burlington, Cedar Rapids, Des Moines, Ft. Dodge, Keokuk, Marshalltown, Sioux City.

Kansas: Abilene, Anthony, Coffeyville, Cherryvale, Caldwell, Emporia, Girard, Hutchinson, Independence, Iola, Kansas City, Leavenwarth, Marion, Newton, Neodesha, Parsons, Pittsburg, Topeka, Wellington, Wichita.

Kentucky: Newport.

Louisiana: Shreveport.

Massachusetts: Gloucester, Haverhill, Lynn, Taunton.

Michigan: Harbor Beach, Port Huron.

Minnesota: Mankato.

Mississippi: Clarksdale, Hattiesburg.

Missouri: St. Joseph.

New Mexico: Roswell.
New York: Fairport.
North Carolina: High Point.
North Dakota: Bismarck, Mandan, Minot.
Oklahoma: Ardmore, Bartlesville, Duncan, Enid, McAlester, Miami, Muskogee, Sapulpa, Tulsa, Wagoner.
South Carolina: Columbia.
South Dakota: Dell Rapids, Huron, Pierre, Rapid City, Sioux Falls, Vermilion, Yankton.
Tennessee: Memphis, Richard City.
Texas: Austin, Beaumont, Corpus Christi, Dallas, Denison, Ft. Worth, Galveston, Greenville, Houston, Kennedy, Lyford, Marble Falls, Marshall, Palestine, Port Lavaca, San Antonio, Sherman, Terrell.
Washington: Tacoma.
West Virginia: Bluefield, Huntington.
Wisconsin: Eau Claire.

The original form of commission government, now known as such, was developed in Galveston, Tex., and as finally put into constitutional form, was simply a city council of five members, which, like the city councils of small cities, both levied the taxes and spent the money resulting from the levy. It developed the same lack of personal responsibility which is a defect in the system of government by common council or board of aldermen, or both, and did not have the checks of veto by the mayor which is common with the council form of government. It concentrated the power in the body of five men, but it gave too much opportunity for shuffling the responsibility among them. All subsequent forms of the so-called commission government have inserted numerous provisions which have the effect of materially modifying the power of the commission, and these have now become so numerous in some cases that the original commission form of government is almost lost sight of.

These additional provisions are quite as applicable to other forms of government as they are to the commission form, and many of them would have quite as salutary effect if applied to those forms, without including the objectionable features of the commission form. This is particularly true of the non-partisan nominations, the double election, the shortening of the list of officers to be voted for. The initiative, referendum and recall were in existence long before the commission form.

Further discussion of the subject will be found in MUNICIPAL ENGINEERING, and reference may be made to the following articles, among others:

Vol. xl: "Comparison of Des Moines and Indianapolis Forms of Municipal Government," p. 8; "The Des Moines, Indianapolis and Boston Plans of City Government," p. 30; "Commission and Other Forms of City Goveernment," p. 45, referring also to earlier articles on the subject; "Small Cities With Commission Form of Government," p. 124; "Information About Commission Form of Government," giving list of earlier articles on the subject, p. 126; "Best Form of Municipal Charter," p. 127; "Use of the Recall," p. 133.

Detroit's Proposed Municipal Creosoting Plant.

The department of public works of Detroit has asked the board of estimates for $30,000 for a municipal creosoting plant. Last spring $100,000 for this same purpose was requested and refused, and since then Commissioner Haarer has discovered that a plant suitable for the use of the city can be acquired for $30,000. This would be operated in connection with the city asphalting plant and no new boilers or power machinery would be necessary.

The city first used creosoted blocks in the paving of the Belle Isle bridge about 6 years ago. A portion of Park street was paved the following year and both pavements have endured without repair to the present time. Since the Park street paving a number of other streets have been paved with wood blocks until at the present time Detroit has about seven miles of wood pavement.

At present these creosoted blocks cost $1.65 a yard delivered here, the whole cost being about $3.50 a yard laid. Cedar blocks, although they have advanced greatly in price as cedar grows scarcer, can be delivered here and laid for about a dollar a yard less. It is figured that if the city makes these blocks, cutting out the profit and one set set of freight charges, they can be laid cheaper than asphalt.

The new plant will be under charge of the present superintendent of the asphalt repair plant, C. A. Proctor.

Shells a Cheap Road Material in Texas.

The counties of southern Texas are fortunate in possessing a cheap road building material, which is found almost at their very doors. This material, mud shell, is said to be very satisfactory for the purpose and has been adopted in some cases for city streets.

The cities of Houston and Galveston use a great deal of the shell, Houston's supply being obtained at Red Reef, about forty-five miles tow from the point where it is placed on cars and transported to Houston. It costs 70 cents per yard f. o. b. Houston, as against $2.80 for a grade of gravel suitable for road work. The city owns and operates two shell dredges, while Texas City and Galveston each have their own shell plants. The International and Great Northern railroad has a plant of its own and uses this material for ballasting the roadbed.

FROM WORKERS IN THE FIELD

Practical Points from Practical People.

Contributions to this Department are invited. Give from your experience for the benefit of others. No matter about the style of the composition, the fact is what is wanted. Use the Question Department for what you want to know; use this Department for what you can tell others.

Chemical Clarification of Water.

To the Editor of MUNICIPAL ENGINEERING:

Sir—In the March number of MUNICIPAL ENGINEERING, in the question department, page 217, under the heading "Chemical Clarification of Water," I notice a question in regard to the number of cities who use sugar sulphate. What was meant by the question in all probability was the chemical in use in the clarification of the St. Louis water supply, in connection with lime; that is, sulphate of iron in the form of very small crystals of the size of ordinary sugar crystals, and which the manufacturers, the American Steel and Wire Company, call sugar sulphate in distinction from the ordinary large size crystals that they formerly manufactured. The sulphate of iron used for water purification in all probability is in the sugar sulphate form.

GURDON G. BLACK,
Engineer in charge, Supply and Purifying Division, Waterworks Office, St. Louis. Mo.

The American Steel and Wire Company writes as follows:

This is a product of this company that we are putting out for water purification and other purposes for which sulphate of iron is used. This sugar sulphate of iron was originated by this company, and we are the only manufacturers of this product in that form; and, because of its convenience, we furnish it in this shape for all the different municipalities where our system of water purification by sulphate of iron is employed, such, for instance, as St. Louis.

B. B. AYERS, Chicago, Ill.

Concrete Foundation Under Steam Railway Track.

To the Editor of MUNICIPAL ENGINEERING:

Sir—Replying to City Engineer, ——, Va.: Two years ago, in building a brick street crossing (about 50 feet wide) of the track of the H. & D. Electric Railway (over which also pass daily a heavy locomotive and 4 to 7 loaded freight cars) the specification for the foundation was as follows: The ties (under 80 lbs. T-rail) shall be laid upon a continuous bed of broken stone 6 inches in thickness, and extending two feet beyond the rails respectively. The track shall be "lined" and packed up to the proper grade with broken stone, and after a locomotive has passed over the track *without causing further settlement* the broken stone under the ties shall be wet, and grouted with 1 to 3 Portland cement grout. It is not intended, however, to form a solid mass of concrete, the aim being to leave the lower inch or so as far as possible open to secure perfect drainage. When all the ties have been thus packed up and grouted and a locomotive has again passed over it *without producing any movement* the spaces between the ties shall be filled to the base of the rails with 1-3-6 Portland cement concrete tamped as directed by the engineer. The bricks are laid on 1 inch sand with joints filled with tar and pitch. The crossing is on 22 degree curve and 3½ per cent. gradient. Neither electric (passenger) nor steam (freight) traffic was interrupted by the work. At present it is apparently in perfect condition. I attribute this promise of permanency largely to the care taken to absolutely exclude water from the foundation.

J. F. ARMOUR, C. E.,
Dundas, Ont.

Method of Locating House Connections in Sewers.

To the Editor of MUNICIPAL ENGINEERING:

Sir—We note in your last issue the inquiry of J. S. S., Summit, N. J., for a method of locating house connections in sewers. The writer had an occasion some years ago to locate some house junctions in a system of sanitary sewers and for this purpose had constructed an apparatus fitted with electric bells, which when pushed through the sewer with sewer rods would register the connections. A bell and a buzzer were used, one for the right and the other for the left hand junctions. If J. S. S.'s system is a separate system our apparatus would answer his purpose; if it is a combined system of larger sewers it will not.

THE W. S. SHIELDS CO.,
Consulting Engineers, Chicago, Ill.

Purification of Brewery Refuse.

The following is a description of an experiment by R. E. W. Berrington, an English sanitary engineer, upon the purification of brewery refuse:

The refuse from the brewery is derived from malting and from the brewing of beer and porter. The malting process is only carried on for part of the

year, and at intervals, also, during part of the period of experiment, large quantities of waste yeast were discharged by the brewery drains to the purification works. All cooling and refrigerating waters are discharged by a separate outlet direct to the river. The quantity of refuse, as in all breweries, varies greatly from day to day and from hour to hour, but on an average amounts to 10,000 gallons a day.

The purification plant at the time the experiments were begun consisted of two settling tanks, each of a capacity of 4,680 gallons and four filters, each 22 ft. by 10 ft. by 3 ft. 3 in. deep, filled with washed coal of peanut size. The plant was arranged in duplicate series, and the refuse was passed through one or other tank, distributed by perforated half-pipe carriers on the surface of one filter, through which it was allowed to percolate continuously to under-drains of 9-in. perforated pipes, and treated again in the same way on a second filter, the effluent from which was discharged into the river. The distribution on the filters was never efficient, with the result that the greater part of the filtering material was not brought into use.

The chief peculiarity of brewery refuse is that it rapidly undergoes acid fermentation, and while in an acid condition is very refractory to the action of the ordinary purifying organisms.

In planning the experiments it was recognized that no efficient purification was to be looked for, so long as the refuse was allowed to undergo acid fermentation, and various methods were adopted to prevent this and to destroy any acidity already present in the crude refuse; and advantage was taken of the duplicate arrangement of the tanks and filters to carry out two sets of experiments side by side.

In one side the effect of a septic tank treatment of the refuse was thoroughly tried. On May 18, 15 cwt. of sludge obtained from a septic tank at a neighboring sewage works was placed in the tank and thoroughly mixed with the refuse. A small scum soon began to form on the surface of the tank, and increased after the addition of another 10 cwt. of septic sludge to the tank contents, but the tank effluent remained as acid as before, and as this scum consisted in great part of spent grains and hops it was certainly not entirely due to septic action. From the 23rd to the 29th of May a bucket of milk of lime was put into the septic tank daily by mistake. This caused the scum to disappear almost wholly, but reduced the acidity of the tank effluent slightly though not entirely. From the 3rd to the 12th of June additional quantities of septic sludge mixed with water were added to the tank and no waste was allowed to enter, the idea being to get septic action started and a scum formed; but very little scum formed even then, and the acidity was only temporarily neutralized when the whole of the tank contents were stirred up, returning again when they were allowed to rest.

The septic tank was then covered with boards, and after a few days a scum began to form, which gradually increased until it was 6 inches thick at the inlet end of the tank, thinning down to a mere skin at the outlet end; but this scum again was chiefly composed of spent grain and hops. The acidity of the tank effluent was moreover only slightly reduced, and never entirely neutralized, and the offensive smell arising from the works was so bad that continual complaints were made by the workmen and proprietors of a mill adjoining. On July 13 it was found that it was the practice to discharge all the waste yeast which could not be sold down the brewery drains, sometimes to the extent of six or seven casks a day. This, however, was then stopped, with the result that a much less acid tank effluent was obtained.

This tank was used as a septic tank from the 5th of May up to the 31st of July, and on no occasion had it produced an effluent free from acid, while the stench from it had become so bad that the brewery proprietors were threatened with an action for the abatement of the nuisance by the proprietors of the adjoining premises, whose workmen had all signed a notice to leave their work on this account. On July 31 the septic tank was emptied of sludge, when it was found that the scum at the inlet end was 6 inches thick, and that there was 22 inches of sludge in the bottom of the tank, of a black, putrid and most offensive character, but alkaline in reaction. This sludge was carted away during the night to a field 500 yards from the road, but even at that distance its offensive smell was so great that complaints were made by people passing along the road, and the whole of the sludge had to be covered with chloride of lime.

The only conclusion to be arrived at upon this experiment is that the method of attempting to deal with brewery refuse by septic tank treatment, even with the addition of a septic sewage sludge, is not one to be recommended. The process causes most offensive smells and does not produce an effluent free from that acidity which is the great hindrance to the bacterial treatment of the tank effluent. The chief good effected is the removal of suspended matters, an end which may be better attained by other methods.

While the foregoing experiments were being made, the other side was being used for the chemical treatment of the refuse. In the first place this tank, having been emptied and cleaned out, was filled up on May 15 with the crude refuse, to which 120 gallons of saturated lime water were added to render it alkaline. Half the refuse from the brewery was then passed through the tank and 30 gallons of lime water were added twice a day. This was not found sufficient to keep the tank effluent neutral, and for a time lime water in a constant flow, equal to 60 gallons for each tankful of refuse, was added to the tank effluent as it passed to the filters. Even this did not act satisfactorily, and by experiment it was found that 300 parts of saturated lime water were needed to render 400 parts of the crude refuse alkaline. Dry-slaked lime was then used and thoroughly stirred up with the refuse in the tank, when it was found that 72 pounds of lime were required in the first place to neutralize the tankful, equal to 107 grains per gallon, and after this 28 pounds of lime per day to keep the tank effluent neutral, this latter quantity being added to the tank at the inlet end. But at times when quantities of yeast were discharged from the brewery it was practically impossible to keep the tank effluent neutral, and for several days after such a discharge the tank effluent remained strongly acid. The discharge of yeast from the brewery was stopped, as has been stated, and it was afterwards found that milk of lime pro-

duced a better effect, although it had to be added in proportion of 30 to 150 grains of lime to the gallon of refuse. By keeping out the yeast and removing the sludge from the tank at frequent intervals, it was finally found that in the form of milk of lime about 45 grains of lime to the gallon of refuse was generally sufficient to keep the tank effluent neutral. This precipitation produced a large quantity of sludge, and after ten weeks of working the tanks were cleaned out, and it was found that they contained nineteen cartloads of solids. These, although rather offensive, were not nearly so productive of nuisance as the sludge from the septic tank.

Other experiments in chemical treatment of the refuse were made in a 36-gallon cask, which was filled with the refuse mixed with the precipitant and allowed to stand until the suspended solids had settled. For several weeks in November copperas in amounts varying from 5 to 11 grains per gallon, and afterwards manganate of soda, 8 grains per gallon, and aluminoferric in small amounts were at different times added along with the lime, but although these precipitants seemed to hasten the deposition of solids they made no practical difference in the tank effluent.

One of the greatest difficulties in the tank treatment of the refuse was the very irregular flow of the waste. Generally in the earlier part of the day the flow was comparatively small, sometimes not reaching more than about 10 gallons per minute, while during the afternoon it would more often be about 15 gallons, with occasional heavy flushes at the rate of 75 gallons. These flushes caused such a current through the tanks that the sludge in them was stirred up, and much of it carried on the filters, with the result that these were greatly choked up with a yeasty mass of fermenting matter, which doubtless led to the further production of acid in the effluent. Before commencing experiments upon the bacterial treatment of the tank effluent, the distributing pipes of the first filter were taken up and relaid in a bed of fine ashes about 6 inches deep, so as to insure a better distribution over the whole of the surface of the bed and to prevent suspended solids from getting into the body of the filter, and valves were placed at the outlets of the beds for the purpose of holding up the liquids, after Dibdin's method. The effect of double contact was first tried as follows:

The first filter was filled according to the flow of refuse, allowed to stand for two hours, emptied rapidly, and allowed to remain empty two hours, and the second filter was used in the same way. At night when little waste was being discharged from the brewery the valves from the filters were left open and the tank effluent allowed to percolate continuously through, while at the same time thorough aeration of the bed was insured.

It was found that the flow of refuse was at times too great to allow the ordinary cycle of filling, standing full, emptying and standing empty, to be carried out, and this sometimes caused the filters to be filled four or five times a day, between 6 a. m. and 5 p. m., although occasionally the filters could be allowed more than two hours' rest. The filtering material was periodically examined and found to have a large quantity of yeast adhering to its surface in a partly decomposed and most offensive state. It was thought that by laying a layer of fine ashes on the surface of the filter as stated, any further accumulation of this yeast deposit in the body of the filter would be prevented, and that already in the filter would finally be decomposed and disappear; but this result was not attained, and at the end of these experiments this coal filter remained clogged with offensive matter. On July 1, with a view of assisting the second bed in this recovery, perforated distributing pipes were fixed on it, through which the effluent from the filter could be sprayed, and a layer of limestone chippings about 2½ inches thick having been laid on its surface, the filter was used for a short time continuously. This reduced the acidity of the effluent for a time, but it soon returned, and the filter was again used as a contact bed.

This first series of filters was fed from May 18 to the end of July with an acid effluent from the septic tank, and good results were therefore scarcely to be looked for; but after the latter date the filters were fed with an alkaline effluent produced by the lime treatment of the refuse, and it was hoped that in time they would recover and be able to produce a considerable amount of purification on such an effluent. This was not, however, found to be the case, and up to the end of the experiment these coal filters remained in an unsatisfactory state, causing the effluent to be acid even when the filter was fed with an alkaline tank effluent.

After testing for some months the possibility of the recovery of the filters, the material in them was thoroughly examined and found to be still clogged with fermenting, yeasty sludge. It was then determined to remove the whole of the filtering medium from the filter beds of one side and to replace it with ashes arranged as follows: The first filter was underdrained with channels formed of loose bricks laid upon the concrete bottom of the bed, and the bed was then filled with four layers of riddled ashes, the bottom layer consisting of 6 in. of clinker sized from 1½ in. to 1 in., then 12 in. from 1 in. to ¾ in., 12 in. from ¾ in. to ½ in., and the top 9 in. from ⅜ in. to ⅛ in.; 3 ft. in all. The second bed, underdrained in the same way, had 12 in. of riddled ashes in 1 in. size, 12 in. ¾ in., 9 in. from ⅜ in. to ⅛ in. 3 in. of fine limestone chippings, and again, 3 in. of fine ashes, free from dust; 3 ft. 3 in. in all. In order, however, to catch the fine suspended matter carried forward from the settling tank by the flushes of liquid, the first bed was covered at the inlet end with an extra layer of fine ashes 3 in. deep. These filters were brought into operation on September 8, and were used regularly after that date, the effluents being always neutral at the time of discharge, although occasionally they have become acid on keeping.

While these experiments were being carried out with the large filters, smaller experimental filter beds were constructed and brought into use. At the end of June, two 36-gallon casks were filled, the first with coke varying in size from pieces of 1 in. at the bottom to pieces between ⅜ in. and ⅛ in. in the top layer, and 2 ft. 8 in. in depth altogether; the second of the same depth, with the same coke in the bottom, but with the top 6 in. filled with Trent sand. The water capacity of each of these filters was 22½ gallons at first, but rapidly fell to 18 gallons, and remained at that figure. On October 12 a percolating or trickling filter was constructed in a similar cask of coke-breeze in pieces about

1 in. in size, partly new and partly taken from some Dibdin contact beds, which had been in use for a long time at adjoining sewage works.

At first the brewery refuse was diluted to the extent of 30 per cent. by mixing with it river water along with a little sludge from the septic tank of adjoining sewage works, and this mixture was supplied to these filters and given two hours' contact in each. After a few days a fairly good effluent was obtained, but before any reliable test could be made the sand in the second filter became choked, and the filter became useless. By turning the sand over, the filter was again brought into use, but choked up again, and finally the sand was removed, and in each filter a layer of fine stone chippings was placed on the surface of the coke.

These three cask filters were used in the first place for dealing with the effluent which was produced by the settlement of the refuse precipitated in the cask which has already been mentioned, but after December 21 were fed with the effluent from the ash filter, and after this the third cask filter was provided with a tap and used as a contact bed. The brewery refuse could thus be subjected to chemical precipitation by lime and other precipitants and double contact in the large ash filters, followed by triple contact in the cask filters of coke. Even this did not produce a satisfactory result, and on no occasion did any nitrates appear in the effluent. It was therefore decided to experiment further with the effluent from the ash filters. A larger sprinkler was therefore constructed and brought into operation on November 9. This filter was constructed on a concrete foundation which sloped from the center to the circumference, the filter being circular in shape, 6 ft. in diameter and 6 ft. deep. On the concrete floor a layer of stones was laid for drainage purposes, on which the filtering material was built up. The material was coke-breeze, about a quarter of which had been obtained from some first contact beds at sewage works, and the remainder fresh from the gas works. The pieces were about the size of apples, and were held in position by upright boards placed at intervals and supported by iron bands. For the supply of this filter, a storage tank having a capacity of 225 gallons was fixed at a sufficient height. This tank was fed by a pump from the valve chamber of the second ash contact-bed, and from the tank the liquid was supplied to the filter by means of a rotating sprinkler. The tank was filled twice a day and discharged each time on to the trickling filter in the course of one hour, giving a quantity of some 75 gallons per square yard, treated upon the filter twice a day, the filter being allowed to rest for the remainder of the day.

The result of this extra treatment was at once apparent, the effluent being free from smell, clear and not frothy, and these improved results have been steadily maintained. The analyses show, however, that even by this treatment of lime precipitation, double contact and percolation, no nitrates were produced in the effluent, and the rate of filtration was therefore greatly reduced, the ash filter effluent being supplied in intermittent doses every five minutes for eight hours a day to the amount of about 140 gallons per square yard per day. By this reduction in the rate, and this method of application, the results obtained were greatly improved, and nitrates appeared in the effluent; and when the filter effluent had been strained through sand to remove from it the suspended solids which are invariably found in the effluent from a percolating filter, the resulting filtrate was one which could be said to be very satisfactory.

A further experiment was made with a view of ascertaining the effect of filtration through natural soil upon such an effluent, and for this purpose an earthen bed was constructed and brought into use on January 11. This bed was 11 ft. by 5 ft. by 5 ft. 6 in. deep. It was constructed on a bricked and grouted floor of gravelly and loamy soil taken at a depth of 4 ft. from some neighboring excavations, with a covering of 1 ft. 6 in. of good garden soil and grass turf. An underdrain lying on the brick floor was provided for the purpose of collecting samples. On to this bed the effluent from the ash filter could be pumped, and was supplied to the earth bed in quantities of some 100 gallons, which was found to be the quantity the filter would take without overflowing, the bed being used on the principle of intermittent downward filtration.

The results of this treatment have been very similar to those obtained by the use of the sprinkler filter, and the effluent produced has generally been very satisfactory, having a low oxygen-absorbed figure and showing nearly always the presence of nitrates in appreciable quantities. These results show that although brewery refuse is more refractory than domestic sewage, it is quite practicable to purify it by ordinary bacterial means, aided by a preliminary treatment with lime.

Taking the average results, the precipitation with lime produces a tank effluent in which as compared with the crude refuse the suspended solids have been reduced from 24.8 to 13 parts per 100,000, and the albuminoid ammonia from 3.8 to 1.8, while the oxygen-absorbed figure is increased to 32.7; it produces, moreover, a liquid which no longer has an acid reaction, although in such a condition that the acidity soon returns. The alkalinity, however, persists long enough to permit of bacterial purification taking place. The double-contact treatment of this neutral or alkaline tank effluent further reduces the albuminoid ammonia from 1.8 to 0.7, and brings the oxygen absorbed figure from 32.7 to 7.9—quantities which are still much too high to be satisfactory. The percolating filter fed with the effluent from the contact beds produces an effluent which, when strained through sand, may be considered very satisfactory, the albuminoid ammonia being reduced to 0.15 parts per 100,000, the oxygen absorbed to 1.8, while nitrates have made their appearance, and the earth filter yields nearly the same result. The purification thus effected by chemical precipitation, double contact, percolation and sand straining, when judged by the amount of albuminoid ammonia, amounts to 96 per cent., and when reckoned on the oxygen-absorbed figure to 93 per cent.

It will be seen that the course taken by the experiments was to a great extent determined by the nature of the existing works. In constructing works anew for the purification of such refuse, the best course to take would probably be to provide tanks for chemical treatment, a first percolating filter, and another at lower level, and finally a shallow strainer of sand for the removal of suspended matters. The tanks should not be too large, for fear of including acid

fermentation in their contents, and the filters should be of sufficient area to allow of only a moderate quantity per yard being passed through them. With such an apparatus there should be no difficulty in producing an effluent quite fit to be discharged into a stream.

Tests of Asphalt for Paving Purposes.

To the Editor of MUNICIPAL ENGINEERING:

Sir—Following are the methods of testing asphalt which we recommend to cities for which we draw paving specifications. They do not cover all the tests called for under some of the more recent specifications, but are sufficiently comprehensive for the purpose intended.

DOW AND SMITH,
Chemical Engineers, New York City.

PENETRATION.—The penetration of an asphalt, asphalt cement or bitumen at 32 F., shall be determined by ascertaining the distance, expressed in hundredths of a centimeter, that a No. 2 needle will penetrate into the material under a weight of 200 grams operating for one minute.

The penetration at 77 F., shall be determined by ascertaining the distance, expressed in hundredths of a centimeter, that a No. 2 needle will penetrate into the material under a weight of 100 grams operating for five seconds.

The penetration at 115 F., shall be determined by ascertaining the distance, expressed in hundredths of a centimeter, that a No. 2 needle will penetrate into the material under a weight of 50 grams operating for five seconds.

These penetrations shall be ascertained by the use of the Dow Penetration Machine and shall be made in the following manner:

The sample to be tested shall be immersed in water at the desired temperature and kept at such temperature at least thirty minutes before being tested. It shall then be placed in a glass dish and covered with water at the desired temperature. The glass dish containing the sample shall then be immediately placed on the shelf of the penetration machine and the penetration of the sample determined in the standard manner prescribed for the use of this machine. The temperature of the water surrounding the sample in the glass dish shall be taken immediately after each test, and no determination shall be considered if the temperature varies more than one-half of a degree from that at which the test was to have been taken.

DUCTILITY.—The ductility of an asphalt, asphalt cement or bitumen shall be determined by ascertaining the distance in centimeters that a standard briquette of the material will draw out before breaking under the conditions hereinafter specified. The test shall be made either upon the commercially pure homogeneous asphalt cement or on the pure bitumen cement obtained by extracting the asphalt with a solvent or the purified bitumen from the non-homogeneous asphalt cement obtained by straining it through sieves.

If the asphalt, asphalt cement or bitumen to be tested contains over 96 per cent. of bitumen soluble in carbon di-sulphide, and is free from lumps of inert bitumen, it shall be considered as sufficiently pure to test.

If the asphalt, asphalt cement or bitumen contains less than 96 per cent. of bitumen, and the bitumen is homogeneous, or nearly so, that is, contains no lumps of inert bitumen, the ductility test shall be made upon the pure bitumen obtained from it by the following method:

Preparation of pure bitumen. Sufficient quantity of the refined hard asphalt, before having been fluxed, to yield 150 grams of pure bitumen, is treated with carbon di-sulphide in an Erlenmeyer flask. After standing for two or three hours, the flask is shaken until none of the asphalt is seen adhering to the sides or bottom of the flask, after which it is set aside and allowed to stand twenty-four hours. The solvent is then carefully decanted off from the residue into a second flask. The residue is again treated with the solvent, shaken, allowed to subside and decanted as before. This is continued until the solvent is practically colorless or of a light straw color. The combined solutions, after standing at least twenty-four hours after the last addition of solution, shall then be carefully decanted off and the solvent distilled off until only sufficient remains to keep the extracted bitumen liquid. The residue is then poured into a large evaporating dish and as much of the remaining solvent as possible evaporated off on a steam bath. To facilitate the removal of the last particles of carbon di-sulphide from the bitumen while on the steam bath, it should be stirred from time to time. After this treatment on the steam bath, one-half to one cubic centimeter of water should be incorporated into the bitumen and the heating continued over a burner until all foaming ceases, after which the dish containing the bitumen should be placed in a hot air oven and kept at 300 F. for thirty minutes. While heating the extracted bitumen over the burner, it should be stirred constantly with a thermometer and care exercised that the temperature never exceeds 300 F.

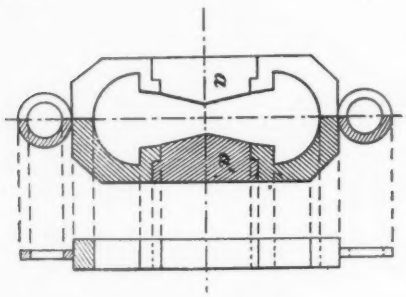
If the bitumen of the asphalt, asphalt cement or bitumen to be tested is not homogeneous, that is, when it contains lumps of hard bitumen which can not be brought into solution in the softer bitumen, even when in a molten condition, it is impossible to obtain a pure bitumen that will have the same relative physical properties as the active bitumen of the cement. Such an asphalt, asphalt cement or bitumen shall be refined by passing it, while in a molten condition, through sieves, thus

removing the coarser lumps of inert bitumen.

Preliminary Treatment of non-homogeneous bitumens. The asphalt, asphalt cement or bitumen shall be heated in an air bath at a temperature between 300 F. and 350 F., together with a 20-mesh sieve and a 50-mesh sieve. When the material is in a thoroughly molten condition, it is first strained through the heated 20-mesh sieve and afterwards through the heated 50-mesh sieve. The molten cement must not be forced through the sieves, but must run through by gravity alone.

The asphalt, asphalt cement or bitumen to be tested for ductility and prepared in accordance with the foregoing, must then be brought to a consistency of 50 penetration at 77 F. by softening it with a flux similar to that which it is proposed to use in the practical work and the test for ductility shall be made on this prepared asphalt cement or bitumen.

The briquette of the asphalt cement upon which the test is made shall be shaped as shown in the accompanying diagram.



Its dimensions shall be as follows: One centimeter in thickness throughout; distance between clips, 3 centimeters; width at mouth of clips, 2 centimeters; width at minimum cross section half way between clips, 1 centimenter. The molding of this briquette shall be done as follows. The mold, as shown in the diagram, shall be placed on a brass plate. To prevent the asphalt cement from adhering to this plate and the inner sides of the two removable pieces of the mould, a and a′, they shall be well amalgamated. The material to be tested is poured into the mold while in a molten state, a slight excess being added to allow for shrinking on cooling. After the cement is nearly cooled the briquette is smoothed off level by means of a heated palette knife or trowel wet with water to prevent its sticking. It should then be thoroughly cooled to the temperature at which it is desired to make the test, after which the clamp and the two side pieces, a and a′, should be removed, leaving the briquette of asphalt cement held at each end by the ends of the mold, which now play the part of clips. The briquette shall then be immersed in water maintained at 77 F. for at least thirty minutes before testing and the test shall be performed while the briquette is so immersed in the water at the above temperature, and at no time shall the temperature of the water vary more than one-half a degree from the standard temperature. The test is made by pulling the two clips apart at a uniform rate of speed by means of hooks inserted in the eyes. The clips shall be pulled apart at the rate of 5 centimeters a minute until the thread of asphalt cement has parted. The distance between the clips shall then be measured in centimeters, and this distance, less the 3 centimeters originally separating the clips, shall constitute the ductility of the material examined.

HEAT TEST.—The loss on heating an asphalt, asphalt cement or bitumen shall be determined in the following manner: Fifty grams of the material shall be weighed into a circular tin box, with vertical sides, measuring 2 centimeters deep by 6 centimeters in diameter, internal measurement. The penetration at 77 F. of the material to be examined shall then be determined in the manner heretofore described. The sample in the tin box shall then be placed in a hot air oven heated to 325 F., and shall be kept at this temperature for 15 hours. During the last two hours of this time the sample shall be stirred each hour with a small stirring rod. At no time shall the temperature of the hot air oven vary more than 15 degrees F. from 325 F. When the sample has been heated for the full five hours, it shall be removed from the oven and well stirred with the iron stirring rod and put on one side to cool. The material adhering to the stirring rod must be carefully scraped off and added to the tin containing the sample, or the rod may be weighed with the sample and the box in the first place. When the sample has cooled to normal temperature it shall be weighed, and the per cent. loss by volatilization calculated. After this the penetration of the residue shall be determined at 77 F., in the manner heretofore described, and the loss in penetration determined by subtracting this penetration from the penetration before heating.

ACTION OF WATER ON ASPHALT CEMENTS.—The commercial asphalt cement, as it will be used in practical work, shall be tested as follows to determine the extent to which it is acted upon by water: It shall be coated on a piece of glass and immersed in distilled water maintained at a temperature between 70 and 90 F. If the surface of the asphalt cement remains bright and shows no corrosion or discoloration from an immersion of seven days, it shall be considered as not being readily affected by the action of water.

Formula for Asphalt Floors.

To the Editor of MUNICIPAL ENGINEERING:

Sir—In further answer to the question on p. 217 of the March number of MUNICIPAL ENGINEERING, we suggest the subjoined specifications for asphalt mastic floors, prepared particularly for use with our own materials.

AMERICAN ASPHALTUM AND RUBBER CO.,
Chicago, Ill.

ASPHALT MASTIC FLOOR SPECIFICATION.

Mastic and Flux.—The asphalt mastic and asphaltic flux to be used shall be produced by the American Asphaltum and Rubber Co., of Chicago. The flux must not be less than 99 per cent. bitumen; shall be absolutely waterproof and unaffected by extremes of temperature.

Mix.—The mix shall consist of about 480 pounds mastic (or 6 blocks), to which shall be added about 6 per cent. of the flux. The mastic shall be broken up into small pieces. After the mastic and flux have been brought to 400 to 430 deg. F., 80 to 85 per cent. clean, dry, torpedo sand or coarse grit shall be added and the same thoroughly mixed by means of mastic spuds.

Process of Laying Floors.—Floor 1 inch thick shall be laid in one layer. Floor 1½ inch thick shall be laid in two layers, each ¾ inch; the bottom layer, however, must not be rubbed smooth, but evenly spread—great care should be taken that no dust be allowed to accumulate on this layer before second layer is laid. The mixture shall be laid evenly in strips 6 feet wide, using a strip of hard wood or steel ¾ inch thick by 1 inch wide, laid parallel with the wall as a guide.

After two strips of the bottom have been laid, second layer ¾ inch thick shall be placed over same. The first strip of this second layer shall be only 5 feet wide, so that each joint in this layer shall overlap joint in first layer about one foot; all remaining strips shall be 6 feet wide. This layer must be rubbed smooth as fast as it is laid, using limestone dust or cement on the surface while rubbing.

When laid on wooden floors, they should be made as clean and dry as possible, then covered with two thicknesses of building paper, or one layer of waterproof felt, before applying the mastic.

When laid on concrete floors they should be swept clean of all dirt and dust, then painted with a heavy coat of "Amarco" asphaltum paint, before applying the mastic.

Joints.—In making joints in both the bottom and top layers, hot mastic should overlap preceding strips laid about 4 inches, so that the edge of the cold strip will become soft, thus allowing the rubber to make a perfect joint after surplus material has been cut away, all joints being first thoroughly painted with hot asphaltic flux.

Waterproofing of Walls and Posts.—All walls and posts should be painted with two coats of "Amarco" asphaltum paint, from 3 to 6 inches above the floor line.

Fillet.—After floors have been finished, put 3-inch fillet around all walls and posts.

Workmanship.—All work to be done in a thoroughly workmanlike manner.

Guarantee.—Should any defects develop during a period of 5 years from the date of completion, due to either faulty material or workmanship, the contractor shall repair same at his own expense, provided, however, such defects are not due to faulty foundation or other conditions not controlled by the contractor.

Difficult Sewer Construction in St. Louis.

In the construction of the $4,000,000 River des Peres sewer in St. Louis, almost all of the difficulties known to sewer engineers will be encountered. The sewer, when completed, will be the longest underground drainage canal in the United States. It will be 12 miles in length, 9 feet in diameter and will drain the largest watershed of any sewer in the country—110 square miles, or 70,000 acres.

Work already has begun on the sewer, R. E. Cooney, active superintendent, is the engineer for Burke & Joseph, contractors. Walter T. Gray, engineer of the Sewer Department, is supervisor. Work on the rock tunnel is rapidly progressing, and the engineers will begin the quicksand tunnel soon.

In cutting the 9-foot tunnel section through the rock formation, about 36,000 cubic feet of excavation will be necessary. In this rock work in which the work is progressing at present a headway of 9 or 10 feet is a good day's work for the crew. The holes in which the explosives are placed are drilled 11 feet. For each day's work 200 pounds of nitroglycerin dynamite are used in each "head." The total length of rock tunnel is about 2,200 feet.

In the quicksand tunnel work, of which there is approximately 1,000 lineal feet, the shield process will be used, a 9-foot shield being necessary. It is estimated that the quicksand tunneling will progress at the rate of about 20 feet per day. An air compressing plant is being erected at present to furnish compressed air for the quicksand tunneling.

At the mouth of the sewer, a difficult proposition awaits the constructors. After drilling the rock tunnel to within 100 feet of the river, the engineers will come to the surface and begin an open trench to connect river and rock tunnel.

To do this they must dig down nearly 100 feet, or 20 feet below low water stage. Necessarily something will have to be done to keep the water from rushing in.

The engineers will surmount this difficulty by going out into the Mississippi

and building a dam around the proposed mouth of the sewer. After having made the dam water-tight, they will pump the water out of it, further strengthen their dyke and begin work on dry ground.

The building of the inside of the tunnel, after the hole in the ground has been made, presents several methods. From the river to the beginning of rock tunnel for 100 feet the sewer tube will be made of four rims of brick, re-inforced over the top and sides with 8 inches of concrete.

In the rock tunnel the walls will be bricked, while in the quicksand tunnel the hole will first be lined with segments of 8-inch timber, sawed so as to fit perfectly in the 9-foot aperture, after which a layer of brick will be laid. In the open trench bricks, re-inforced by concrete, will be the method. The four layers of brick in the first 100 feet will be placed there on account of the heavy hydrostatic pressure the sewer will have to withstand, owing to its location beneath the river.

MUNICIPAL MATTERS IN COURT

Decisions of the Higher Courts of Interest to Municipalities.

Water Franchise as Property—Under the law of Wisconsin, a franchise granted to a water company by a city to build and operate a water works system therein is regarded as the principal thing to which the other property acquired by the company, real or personal, is an incident; the whole being personalty so long as owned by the company. Trust Co. of America vs. City of Rhinelander, Wis. 128 F. 64.

Damages Due to Water Pressure or Corrosive Effect—Plaintiff, having a contract with defendant water company for water supply, alleged that defendant was bound to furnish water under reasonable pressure, but that it negligently supplied water of a harmful character and of such a high and abnormal pressure as to corrode plaintiff's pipes so that one of them burst and caused damage, etc. *Held,* that the complaint stated a single cause of action; the corrosive nature of the water and the abnormal pressure being stated as co-operative causes in producing the injury. Miles vs. Charleston Light & Water Co. (S. C.) 69 S. E. 292.

Liability of Contractor for Error in Bid—Where a bidder on a municipal contract inadvertently made an error in footing up items, so that the amount of his bid was one-tenth of the amount intended, which error was patent upon the face of the bid itself, the bidder will be relieved from liability for damages for breach of an agreement contained in the bid to carry out a contract upon the terms stated in the bid. City of New York vs. Doud Lumber Co. et al. (N. Y.). 125 N. Y. S. 394.

Failure to Fix Water Rates—Injunction—Where water rates have not been fixed by the board of aldermen, as provided by Greater New York charter, an owner of an apartment house is entitled to an injunction restraining the municipal authorities from cutting off his water supply, on condition that he permits the meter to be installed to measure the water actually used while the injunction continues. Johnson-Kahn Co. vs. Thompson et al. (N. Y.). 125 N. Y. S. 443.

The Right to Extend Water Mains.—Where a municipal water company sought to justify laying enormous pipes through the city's streets upon the ground that they were going to extend their mains without the corporate limits to supply people on adjoining roads, a thing the company could do under the direct provisions of the statutes, upon condition that the consent of the owners on the road be secured, the consent of such owners is a condition precedent to compelling the city to allow the extension, and, until that be shown, the company is not entitled to a preliminary injunction to restrain the city from preventing the laying of the pipes.—Somerville Water Co. v. Borough of Somerville (N. J.), 78 A. R. 793.

The Right of a Municipality to Furnish Light.—A municipality cannot furnish lights for private use, unless specially authorized.—Rand, Collector v. Marshall (Vt.), 78 A. R. 790.

Gratuitous Services to a Municipality May Be Terminated at Will.—If one agrees to perform a certain service for a village gratuitously, he may withdraw such promise at any time before the same is performed, and notice of such action is sufficient, if duly given to one member of a committee of the village board in charge of the improvement upon which the services are performed, and if the committee then continues his employment, the village will be liable for the value of the services thereafter rendered.—Launt v. Village of Oakdale (Neb.), 129 N. W. 258.

Water Department Expenses Payable from Current Expense Fund.—In the absence of a showing of apportionment by

the city council of the current expense fund created by the statutes among the several departments of the city, it is *held* that the expenses of the city water department are payable from the current expense fund.—State ex rel. Briggs et al v. McIlraith, city treasurer (Minn.), 129 N. W. 377.

The Signing of a Paving Petition Does not Prevent Action for Damages in Case of Injury.—Where, when a petition for paving a street was presented to the trustees of a village, the plans therefor had not been made, and one signing the petition was told by the trustees that the construction of the pavement would cause no appreciable change in the grade of the street that would damage his property, and signed in reliance on such statement, and it did not appear that the paving could not be done without making so great a change, petitioner was not estopped from claiming damages for changing the grade.—Stillman v. Village of North Olean (N. Y.), 126 N. Y. S. 728.

Water Company's Liability for Damages Due to Fire.—Where the contract between a city and a water company provided that the company should supply sufficient water for protection against fire, and that it should supply private fire plugs as well as the ordinary private demands, the company was not liable to one who did not have a private fire plug, for destruction of property owing to its failure to supply sufficient water for fire protection, but such person could recover under the contract between the company and the city, on showing that the water pressure in the general mains was wholly insufficient for general fire protection.—Kenton Water Co. v. Glenn et al (Ky.), 133 S. W. 573.

The Right of a City to Make a Charge for Sewer Connections.—A city ordinance which reserves to the city the exclusive privilege of building lateral sewers from the property line to the public sewer, and which makes a uniform charge of $20 therefor, is not so unreasonable as to be void, merely because the expense to the city is not the same in every case, because some lots are nearer to the sewer than others.—Harter v. Barkley et al (Cal.), 112 P. R. 556.

Engineer's Certificate Required before Assessment for Improvements Can be Levied.—The certificate of the city engineer that the work has been completed in accordance with the contract is essential before the city officers can properly levy assessments against individual property for the payment of the cost of a sewer.—Baker v. City Council of City of La Moure et al (N. D.), 129 N. W. 764.

Operating Expense of Purification Plant May Not be Capitalized.—The contract between a water supply company and a city under which waterworks were constructed by the former for supplying water to the city, provided that the operation of sewage disposal works constructed by the company shall not be an expense to the city, and further provided that if the waterworks were purchased by the city under its option to purchase, they should be delivered to it "as a completed, operating plant, free from pollution as aforesaid." The city claimed, in a suit to compel the transfer of the waterworks under its option to purchase, that the annual cost of operating a device for removing germs should be capitalized, and, as capitalized, be deducted from the contract price. *Held*, that the company's contract was to deliver a plant, and not the money with which to operate it, and the cost of operating such device should be borne by the city; such cost not being a part of the completed plant.—Mayor, etc., of Jersey City v. Flinn et al (N. J.), 78 A. R. 391.

Liability of a City for the Character of Its Water Supply.—A complaint charged that defendant city negligently allowed the supply in its waterworks system to become polluted with poisonous substances, and large quantities of filth and sewage to escape into and saturate its water supply, by reason whereof plaintiffs' intestates contracted typhoid fever and died as a consequence. On demurrer it is *held*, (1) The municipality was liable for its negligence in its private or corporate capacity, and was not exempt because it was carrying out a governmental function. (2) An administrator of a person whose death was due to the wrongful act of a municipality may maintain an action for damages conseqnent thereon.—Keever v. City of Mankato. Flanagan v. Same (Minn.), 129 N. W. 158.

Liability of a City under Franchises of a Purchased Water Company.—The city of Mobile was authorized to build or buy a waterworks system to furnish water at usual rates, etc. Under this act the waterworks was built, and later the plant of a private company was purchased, and water was supplied through the purchased company's mains, etc. The franchise of the purchased company provided that it should furnish water to the municipal buildings and hospitals, and to the courthouse and jail, free of charge. *Held* that, as the act above refrred to did not authorize the inference that the power conferred was to be burdened with the duty of furnishing water to the public buildings of the county, the purchase of the private company's property did not burden the city with its franchises, for the duty was not upon the property, but upon the franchises of the water company.—City of Mobile v. Mobile County (Ala.), 53 S. R. 793.

Water Supply May be Shut off in Case of Willful Waste.—For failure to pay a valid claim for willful or unreasonable waste or for fraudulent use of water, the

supply may be cut off until the waste is stopped and all arrears paid.—J. N. Mathews Co. v. City of Buffalo et al (N. Y.), 126 N. Y. S. 596.

The Definition of "Channel."—The "channel" of a stream, in its larger sense, is its bed from bank to bank; the hollow or course in which the water flows.—Village of Prairie Du Rocher v. Schoening-Koenigsmark Milling Co. (Ill.), 93 N. E. 425.

One Contractor not Liable for the Incomplete Work of Another on the Same Job.—Plaintiff contracted with a city to pave certain streets, the contractor to excavate the subsoil to a specified depth, and if rock should be encountered, it was to be removed for at least three inches deeper. Several years before, the city had let contracts for grading the streets in question under which all rock was to be excavated to a depth of two feet below the curb line and the excavation then refilled with soft filling to the street level. Under such previous contracts, the contractors had received payment in full upon proper certificates that the work had been fully performed. Such contracts were on file as public records with the certificate showing the full performance of the work and payments therefor. When plaintiff undertook to excavate the streets, he found that the rock had, in fact, been removed to a depth of only about a foot below the curb instead of two feet and was required, over his protest, to remove the rock which should have been removed under the former contracts. *Held,* that the parties to the contract did not contemplate that the contractor would have to remove the rock which was supposedly removed under the former contracts, and the contractor, being compelled to make such excavation to perform his contract, there could be a recovery therefor as for additional work.—Dunn v. City of New York (N. Y.), 126 N. Y. S. 61.

A Court Will Not Interfere in the Management of a City So Long as the Officers Are Within the Limits of the Statute.—Courts will not interfere with the management of the municipal affairs of a city by its chosen officers, so long as they are within the limits of the power conferred by the statute, and it is not shown that in the enactment of ordinances they were influenced by malice, or fraud, or actuated by an unreasonable or capricious spirit.—Town of Lagrange v. Overstreet (Ky.), 132 S. W. 169.

Time Limit of Contract May Not Be Extended after Time of Performance Has Expired.—A contract for public improvements which provides for a certain time of completion cannot be extended by an ordinance of the common council passed after the time of performance has expired.—Paul v. Burress (Mo.), 132 S. W. 330.

Meter Readings Are Not a Record of Quantity of Water Delivered.—Where books of a city water department purporting to show delivery of water to defendant were not in fact a record of the sale and delivery of water, but of conclusions drawn by the water department from readings of various meters and conduits leading to defendants premises, the books were not evidence of a sale and delivery of water to defendant.—Mayor and Council of City of Bayonne v. Standard Oil Co. (N. J.), 78 A. R. 146.

Open Ditch May Not be Substituted for Drainage Pipes without Legal Right.—The attempt to make and use the open waterway in place of the drainage pipes without obtaining the consent of the grantor or the legal right to do so may be restrained by injunction.—Boleno et al v. City of Hutchinson (Kan.), 112 P. R. 129.

Los Angeles Municipal Water System.

The municipally owned water system of Los Angeles, Cal., seems to be a decided financial success according to the figures from the annual report.

Last year, that is, for the year ended June 30, 1910, according to the city's books, the water department earned $1,107,199. Its operating expenses were $239,792, and its profits, therefore, were $867,407. This profit makes it possible to put a capitalized value on the plant. The amount represents 6 per cent. interest on a capitalization of nearly $15,000,000. The rate is probably too high. With conditions as they are 5 per cent. return on the investment would be considered adequate by private capital, and at this rate the capitalized value of the property would exceed $17,000,000.

When the city bought the plant it paid $2,000,000 for it. Later it paid $337,500 for the West Side Water company's plant, adding it to the system. Every year, under municipal ownership and control, the department has shown big profits. In 1902 it made $408,000 in round figures above expenses; in 1903, $537,000; in 1904, $664,000; in 1905, $758,000; in 1906, $819,000; in 1907, $866,000; in 1908, $902,000, and in the period from November 30, 1908, to June 30, 1909, when a charter amendment changed the fiscal year so that it ends in June instead of November, it earned $474,000.

These annual profits have been used for the benefit of the whole people, not alone the taxpayers, for water rates have been kept down and the efficiency of the service has been kept up. In addition, the department has relieved the taxpayers at large of the payment on the water works bonds and has even taken care of a part of the interest and sinking fund on aqueduct bonds. The remainder has been used in extensions and other betterments to the system, so that the property is becoming more and more valuable every year.

The actual physical value of the plant

today, figuring what the property would bring if sold at a forced sale, is nearly $6,000,000. In addition to the amount shown on the books as profit there is a further profit to be considered. The city itself is one of the heaviest consumers of water. Millions of gallons are used annually in the parks, on the streets, for flushing sewers and a score of other public uses.

No charge is made the other departments, but the amount estimated to be used this year if charged for at ordinary rates would cost $216,519, and it is fair to figure this, too, as profit to the taxpayers.

CURRENT INFORMATION

Cheap Gas in Oklahoma—Conduits of Lincoln Park Electric System—Pittsburg Transportation Problem—Suggested Garbage Receptcle Ordinance for St. Louis—Automatic Sewage Pumping Stations—Beautifying Fifth Avenue—Providence Playgrounds Popular

Cheap Gas in Oklahoma.

A company has recently been organized and incorporated for furnishing gas for the city of Claremore, Okla. The company is capitalized for $50,000, the control being held by local capital. The gas is to be secured from fields near Collinsville and piped a distance of ten miles to the city limits. It is proposed to furnish the gas to local factory concerns at a rate of 3 cents per thousand cubic feet.

Conduits of the Lincoln Park Electrical System.

The extension of the boulevard lighting system of the north portion of Chicago, to include Lincoln park and the boulevards leading to it, has been productive of some very excellent construction details as relates to this class of work. Chief among these are the various improved methods adopted in conduit construction.

It was necessary, for a number of reasons, that not only the lighting wires, but those for the telephone system, should be placed beneath the ground. Economy demanded that, if possible, both the wire lines should be placed within the same trench, and within the same condiut if possible. Telephone engineers were doubtful of the practicability of the latter, by reason of troubles arising from induced currents, leakage, etc.; but the success of the plan adopted has proved these fears to have been wasted. The system has been in use since June, and not the slightest difficulty has been experienced. This fact is remarkable when it is considered that the telephone ducts adjoin up to eight to twelve ducts of 6,700-volt, single-phase lighting circuits and 4,000-volt, three-phase power circuits. The telephone lines are metallic circuits placed in paper-insulated and lead-covered cables.

All the conduits laid were of bituminized fiber duct, manufactured by the American Conduit Co., East Chicago, Ind. The method of laying this conduit was very simple and relatively low in cost. The trench was prepared to the desired depth, and in it was placed a layer of concrete which was tamped down. Upon this base the duct was laid, only three men being required to handle it. One of these dipped the ends of the duct into hot bitumen, and the other two placed them in the trench; the one fitting the counterbored ends together, and the others pushing the duct into place to make a tight joint. Where the conduit comprised several layers of ducts, concrete was placed between each course, filling the space between the adjacent ducts. Concrete was then placed over the top layer of ducts and the whole was thus made an integral mass. A portable concrete mixing plant was used, and the work was carried on with considerable speed.

The bituminized fiber conduit has proved to be low in first cost, cheap and easy to lay, and under the severe conditions just described has demonstrated its properties of insulation.

The Pittsburg Transportation Problem.

The monumental report of Bion J. Arnold on the Pittsburg transportation problem is published in a book with a portfolio of drawings, and will serve as a model for this kind of work. While Pittsburg's problem is more difficut than that of most cities, it contains practically all the elements which might present themselves for consideration in any city, so that the principles of some part of the report, at least, can be applied in any other city.

Automatic Sewage Pumping Stations.

A number of plans have been under consideration in New York City involving the use of automatic pumping stations for small areas where the elevations are too low to permit of gravity sewers. The report of the chief engineer of the board of estimate and apportionment contains a reference to the investigation of the subject. This reference is briefly abstracted in the following:

In 1908, the board authorized the installation of a temporary plant on the St. Nicholas avenue sewer, to provide an outlet for the dry-weather flow into an existing sewer. The pump chamber of this station has a depth of about 40 feet. Inspection after the station had been in operation for some time showed that the surface drainage had been admitted in large volumes to the sewer, much overtaxing the capacity of the station. This excess flow was in part removed by a high-level overflow, while the remainder was temporarily stored in the trunk sewer, converting it for the time into a septic tank, leading, of course, to disagreeable odors and complaints from those residing near the station.

Notwithstanding the fact that the operation of the station was limited to the day periods and that an attendant was assigned to its constant supervision, the plant was very frequently out of commission. It is believed that the troubles experienced arose from an overtaxing of the capacity of the plant, though part of the blame is ascribed to the dampness of the chamber and its effect on the machinery, and to faults in the design of the machinery.

The experience with the St. Nicholas avenue station and the possibility of the city being confronted with large damage claims as a result of the failure of future plants that should be installed, led to the investigation of conditions in New Orleans, where entire reliance is placed upon such pumping stations. Assistant Engineer John E. Hill was assigned to the investigation, and his report is partially transcribed in the report of the chief engineer.

New Orleans being built on very flat ground, with the highest elevations at the points of outfall, it is impracticable to install any sewerage system which will deliver the sewage flow of all sections of the city to the necessary points of outfall by uninterrupted gravity. Consequently automatic pumping stations, electrically connected with central stations, have been designed along the lines of the main intercepters and their principal tributaries. Of the thirteen designed automatic sewage-pumping stations, but six are at present built. The pumps are all centrifugal pumps, directly and vertically connected to induction motors; and all friction bearings and working parts are smothered in oil. Each inlet sewer discharges into a shallow suction pit having extended vertical walls.

All these six sub-stations are built of reinforced concrete and have their pumps set in a dry well, with the center of the pump casing below the level of the center line of the inlet sewer. They are provided with automatic regulating devices connected with float chambers and so arranged that the pumps will go into operation at their full rated capacity when the inlet sewer is seven-tenths full, and will cease when that sewer has been pumped dry at the suction pit end. They are also provided with secondary float chambers and cable devices used for automatically sounding signal alarms at the central station. Each chamber is connected with the primary duct, and when the water in the sewer rises above the seven-tenths full level, lugs on the cable throw a connecting arm into the circuit, and a continuous alarm is rung and an annunciator falls at the central station. An emergency by-pass leading from the suction pit to the discharge sewer is also provided; and this comes into operation when a sudden breakage occurs in machinery or in cable, or when a prolonged suspension of power renders the plant, for a time, inoperative.

Besides these installations, each station is provided with a set of incandescent lights, a ventilating fan, an automatic gauge for recording sewage height, a transformer, a switchboard, a hydraulic-siphon sump pump and a compound inlet-outlet ventilating stack with hooded cowl. The lights, the ventilating fans and the pressure pumps operate to keep the stations dry, warm and fit for electrical apparatus. They have been found necessary, even though such apparatus is well encased and protected.

Each station is visited once each day and receives a careful inspection and attention, lasting, normally, about fifteen minutes in each station. The intelligence devoted to the general superintendence and to the daily inspections was strictly high grade, and has resulted, apparently, in maintaining absolute reliability in the automatism of the starting devices and in the precision of the operating machinery; and it is claimed that, except during floods and two isolated occasions, this perfect automatism and precise operation had continued without interruption, damage or significant cost of repairs, twenty-four hours a day, every day of the last three years.

The factors which have led to the success of the New Orleans station are briefly noted by Mr. Hill as follows:

(a) Broad and generous design, fortified by splendid construction and hair-line inspections.

(b) Intelligent and methodic watchfulness over both daily routine and working machinery.

(c) Shallow suction pits instead of re-

ceiving wells and the combined alternating and supplementary character of all pumping units.

(d) Short runs and small lifts, with the avoidance of the necessity for screening.

Suggested Garbage Receptacle Ordinance for St. Louis.

The Civic League of St. Louis has caused to be introduced in the Municipal Assembly a new draft of the garbage receptacle ordinance about which there hsa been considerable discussion in the past. The ordinance passed in 1909 has proven to be unenforcible on account of a division of responsibility between owner, lessee and tenant as to the purchase and maintenance of the receptacles.

The new draft has been drawn with great care by the league's attorney, Chas. P. Williams, under practical provisions decided upon by the Housing and Sanitation Committee, J. Hal Lynch, chairman.

The bill provides:

1st. That it shall be unlawful to deposit garbage in or upon any place in the city of St. Louis except as provided in the ordinance.

2nd. The ordinance provides that all garbage shall be placed in water-tight metal pails or cans provided with tight-fitting covers and handles.

3rd. The ordinance defines garbage as waste or refuse matter, animal and vegetable, derived from the preparation or use of meat, fruits, vegetables, etc., including also small dead animals. Ashes, crockery and glass may not be placed in garbage receptacles.

4th. The provisions of the present ordinance regarding the placing of these cans are repeated in clearer terms.

5th. The duties of the Street Commissioner and Police Department in the matter of collections and notices of hours of collection are the same as under the present ordinance.

6th. The duty to maintain the receptacles required devolves primarily upon the tenants or occupants of a single dwelling or apartment and any building containing not more than four apartments. The same duty devolves upon the person or firm conducting any restaurant, hotel, etc. In all of the cases it rests upon the landlord immediately above the tenant and upon the landlord's agent where the premises are let out or rented.

7th. A penalty is provided for the willful removal or overturning of any garbage receptacle.

The health authorities and persons conversant with conditions in the poorer sections of the city have found that the evil of loose garbage has not been settled by the passage of the ordinance in 1909. The danger to health from the exposure of garbage is great not only on account of the decaying waste, but particularly from the fact that it is a breeding place for flies. This garbage receptacle bill is a health measure of the first importance, and it is expected it will not meet opposition.

Beautifying Fifth Avenue.

A recent issue of the *Municipal Facts* of the City of New York contains mention of the movement being made for the beautifying and improving of Fifth avenue. A meeting of the Architectural League of New York recently took up the question in its various phases. This discussion was materially aided by a report of a committee of the New York Chapter of the Institute of Architects, recently appointed to devise plans for the betterment of Fifth avenue. This committee consisted of John M. Carrere, of Carrere & Hastings, who are building the new Public Library on Fifth avenue; Albert Brunner and William M. Kendall, the latter of McKim, Mead & White.

Those advocating architectural changes on the avenue desire, for one thing, that there be some sort of regulation as to height of buildings. It has been shown, they say, that buildings over ten stories high along Fifth avenue are not only unsightly but unprofitable.

Second, they hope to see in time uniformity in the treatment of the facades of Fifth avenue's buildings, and—equally important—proper architectural treatment of side walls, which nowadays are often shockingly bare and ugly. Already those about to build along the thoroughfare have been approached, and in some cases, after conferences with the friends of "Fifth Avenue Beautiful," they have materially altered their designs in such a way as to benefit the avenue as a whole.

The side-wall question arouses the ire of architects most readily. Anyone walking along the avenue can understand this. Over and over again low buildings are dwarfed and "uglified" by great adjacent side walls, entirely unadorned—nothing more nor less than huge heaps of bricks. This is because those who built the adjacent building thought their duty done when they provided an ornamental and often pretentious facade.

One scheme to beautify these blank walls is to install window boxes along the avenue; there is another for getting Fifth avenue merchants to keep their windows lighted well into the night, and arrange beautiful window displays, thus attracting thousands of out-of-town people to the street at the hours when now it is "dead."

Those advocating the planting of trees on Fifth avenue are fully aware that the cost will be great, but, as one of them points out, the city can have rows of

trees along the avenue if it is willing to pay for them.

"Probably the best kind would be Norway maples or Oriental planes," said a landscape architect. "They would have to be in huge flower-pots, with some sort of reservoirs or vaults under the sidewalk to keep them alive. There are trees from Fifty-ninth street north on one side of the street—why not all the way on both sides?"

"Wealth is so great along Fifth avenue that the cost of tree planting would be, relatively, a small outlay. It might be done by combination among those whose property fronts the thoroughfare. Each property owner might put in two trees, let us say, at cost of about $200 or $300."

Prominent in the practical betterment of the street is the Fifth Avenue Association, founded four years ago. Then it was a mere group of people; now its membership is over 300, recruited chiefly among property owners, business men and residents in the Fifth avenue section.

MUNICIPAL AND TECHNICAL LITERATURE

Engineering Data—Books for Engineers

Engineering Data.

The little collection of facts called "Data," which has been coming monthly for about half a year at the price of $1 a year is rapidly demonstrating its value to the engineers. Ten cents will get a sample copy if sent to "Data," at 92 La Salle St., Chicago, Ill., and will show that it is supplying a field that needs help.

Books for Engineers.

Conversations on Electricity. By Joseph G. Branch, B. S., M. E. An elementary work written expressly for engineers and students. First part. Cloth, 282 pp., 105 illustrations, $2. Rand, McNally & Co., Chicago, Ill.

The author has chosen the dialogue form for this work, which indicates the type of student for which it has been prepared. The large number of sample diagrams used as illustrations adds to the effectiveness of the treatment. The twenty-eight sections cover the field of the elementary theory of electricity and electrical machinery, and the author is unusually clear in his forms of statement and in his development of the subject. The book should be of much value to the young student who wants to get an elementary knowledge of the subject of electricity from a book.

Cost Keeping and Management Engineering. A treatise for engineers, contractors and superintendents engaged in the management of engineering construction. By Halbert P. Gillette and Richard T. Dana. Cloth, 339 pp., $3.50 net. The Myron C. Clark Publishing Co., Chicago, Ill.

The discussion of cost keeping and cost analysis in such organizations as the American Society of Engineering Contractors revives interest in this book, which compiles in a single volume material which is scattered through many papers, books and periodicals. In addition to the authors, who are responsible for the general discussions in the first five chapters or so and for the compilation of the rest, contributions to data, forms and discussions thereof are drawn from Gilbreth, Taylor, Moore, Worden, McCullough, Emerson, Hall, Guthrie, Steffens, Wason, Fisher, Lockwood, Keating, Hallihan, Cummings, Humphrey, Falk, Hammalt, Low, Newell, Hill, and numerous railroads, contractors and others.

The science of cost keeping and management engineering is not yet old enough to have received its full development. The rather hasty consideration of the subject by the authors of this book adds much to the material and the data they have collected add much more, so that, while one cannot accept as gospel anything given in the book and may be confused by the mass of not very well correlated material, if he will stick to his study and experiment, he can find help in almost any line in which he may be engaged.

Modern Methods of Street Cleaning. By George A. Soper, Ph. D., M. Am. Soc. C. E. Cloth, 201 pp., $3 net. Engineering News Publishing Co., New York.

This book is the result mainly of a trip to Europe and much of it is taken up with general descriptions of machinery and methods used for cleaning streets and disposing of the refuse in London, Westminster, Manchester, Paris, Berlin, Hamburg, Cologne, Amsterdam and New York.

The opening chapters treat in a theoretical way the sanitation of cities, particularly of the city streets, of methods of

preserving the cleanliness of streets, of making and enforcing ordinances therefor; of methods of cleaning streets by the use of brooms, by water flushing and with the use of rubber scrapers and sprinkling; of disposal of refuse, including garbage and refuse. These chapters are all very brief, occupying less than 40 pages in all. A summary of European methods precedes the descriptions of the various cities. It includes the methods of organization, the character of labor, the plant and equipment, disposal of sweepings, removal of snow, collection and disposal of house refuse.

The figures showing cost are mainly totals, and there are but few cost details which can be applied in other cities. Nor are the details of methods any more thoroughly presented. From this point of view the book is rather disappointing. On the whole, however, it is of much interest and presents the general subject in a readable and logical form.

Backbone of Perspective. By T. U. Taylor, C. E., M. Am. Soc. C. E. Cloth, 56 pp. The Myron C. Clark Publishing Co., Chicago, Ill.

The author publishes these notes to save the time of his students in note-taking, and they will be of interest to anyone desiring to obtain a simple working knowledge of perspective, shades and shadows. Apparently no previous knowledge of descriptive geometry is necessary, as the necessary principles of that subject are all presented. A chapter on axometric projections requires much more mathematical knowledge than any other part of the book.

Elements of Water Bacteriology, with special reference to sanitary water analysis. By Samuel Cate Prescott, assistant professor of industrial biology and Charles Edward Amory Winslow, assistant professor of sanitary biology in the Massachusetts Institute of Technology. Cloth, 270 pp. $1.50 net. John Wiley & Sons, New York City.

The practical work of testing the sanitary condition of a water supply by biological methods is well described in this little volume by men who are familiar with every step of the process and with the history of the development of the modern methods.

The nature of bacteria, their occurrence in natural waters and the significance of their occurrence are well stated in the first chapter, and the methods of making quantitative bacteriological determinations are described in detail in the second chapter. The third chapter gives the discussion of the interpretation to be made of the quantitative analysis. The interpretation is restricted in the fourth chapter to the bacteria which develop at the body temperature.

The most important bacteriological study begins in the fifth chapter, which gives in detail the methods of isolating specific pathogenic bacteria, and continues in the sixth with methods for the isolation of the colon bacillus, and in the seventh with a discussion of the significance of the presence of that bacillus in water. The eighth chapter gives shorter tests for the colon bacillus, which are more practical in application, though not quite so exact in their indications.

Methods of testing the presence of other intestinal bacteria are outlined in the ninth chapter, and the tenth shows clearly the significance and applicability of the bacteriological examination of potable waters. The bacteriology of sewage and sewage effluents receives a brief treatment in the eleventh chapter.

The appendix gives full specifications for preparing the various media for the cultivation of bacteria of various kinds, the apparatus, formulae, etc. The book closes with a full bibliography of books, reports and articles referred to or used in the preparation of this book, which occupies a field not so well covered by any other book, and which is at the same time valuable to the technical bacteriologist and to the water engineer who wishes to obtain a clear idea of the subject.

There have been considerable advances in some directions during the four years between this second edition and the first edition, which was reviewed in MUNICIPAL ENGINEERING, vol xxviii, p. 410. These have been well covered by the 65 pages or more added to the first ten chapters and the eleventh chapter, which is entirely new.

The standard methods adopted by the committee on Standard Methods of Water Analysis are included in full. The activity in the study of details is suggested by the increase of about 80 per cent in the number of articles referred to in the bibliography.

Concrete Bridges and Culverts for Both Railroads and Highways. By H. Grattan Tyrrell, C. E. Flexible leather, 272 pp., 66 illustrations, $3. The Myron C. Clark Publishing Co., Chicago and New York.

The author has attempted in this book "as far as possible to eliminate mathematical formulae" and to present only what "is directly required in the design and construction of ordinary concrete or masonry arches, so it will be unnecessary for the busy engineer to spend valuable time and thought in the perusal and study of abstruse mathematical treatises." Within this restricted field he has succeeded in making a practical book which may serve as a convenience in getting together the data and compiling a design for an ordinary arch or flat topped bridge or culvert. It is manifestly impossible for such a book to provide the material for the design of every problem which may arise in its field.

The first part, 95 pages, is devoted to plain concrete arch bridges. After a general discussion of the principles of arch

design and the various forms of arches and their loadings, working unit stresses are assumed and methods of determining the line of resistance, point of rupture, thickness of arch ring, etc., are briefly outlined, designs for abutments, foundations, piers, etc., are suggested, and some data for approximate estimates of cost are given, followed by some of the details of a number of stone and concrete arch bridges, and a tabular statement of the principal dimensions of 56 concrete bridges varying in span of principal arch from 20 to 320 feet constructed and 703 feet proposed.

The second part takes up reinforced concrete arch bridges in a brief way, with a historical outline, a statement of the advantages of reinforced concrete, a discussion of adhesion, bond, and two or three methods of reinforcement with steel. Units of stress are assumed and the theory of the arch is again briefly stated, with an unexplainable exchange of the names of Greene and Cain as exponents of the graphical and analytical methods of analyzing the stresses in arches. Then follow some observations on the general design of an arch as regards each of its principal components and some data for estimating cost, including a table of approximate estimating prices upon various materials and operations, and a table of approximate quantities for arches of various spans. Some brief illustrated descriptions of existing arches are given and a table of the principal dimensions of 122 reinforced concrete bridges varying in span from 33½ to 259 feet.

Highway beam bridges and methods of design are briefly considered in the 8 pages of the third part.

Concrete culverts and trestles receive some attention in the fourth part, the large structures being briefly mentioned and the smaller structures and slabs being treated in tabular and diagram form and shown in dimensioned drawings, accompanied with itemized statements of the cost.

The Design of Highway Bridges and the Calculation of Stresses in Bridge Trusses. By Milo S. Ketchum, C. E., consulting engineer, dean and professor of civil engineering, University of Colorado. Cloth, 558 pp., 77 tables, 300 text illustrations, 8 plates, $4 net. Engineering News Publishing Co., New York.

Professor Ketchum has given us another of his practical books, covering a field which has been neglected for some years, and he has done his work thoroughly and well. The first part, occupying 190 pages, is devoted to the determination of the stresses in street bridges. It shows all the standard designs of trusses, gives the detail of estimates of weights of bridges of various designs, for both highways and railways and for loadings, gives clear statements of the algebraic and graphical methods of analyzing trusses and determining the stresses in their members, with examples of their application to both highway and railroad bridges with most of the forms of truss that are in use.

The second part goes into the detail of the design of highway bridges, short span, beam, plate girder, low truss, through and deck girders, riveted and pin connections, showing the advantages and disadvantages of each detail devised or described, and giving the standard specifications for loads, allowable stresses, qualities of material and workmanship, and the standard designs and arrangements of details adopted by the most prominent bridge manufacturers and designers. It also gives the principles governing the design of foundations, piers and abutments and such specifications for stone and concrete masonry as are necessary, with tables of standard dimensions, weights, materials, etc. One chapter in this part discusses the analysis of stresses in solid masonry arches, as a basis for the design of masonry bridges and culverts, and another gives a brief discussion of the applications of reinforced concrete to the same work, with numerous examples, which are fully described and illustrated, wth detailed statements of cost. The selection of areas and shapes of waterways is also well considered. The discussion covers everything from the great concrete arch to a vitrified or concrete pipe culvert. One brief chapter gives the essentials of the design of timber bridges. Another takes up the erection, the estimates of weights and the costs of highway bridges in detail and manner never before attempted. This part closes with a consideration of the general principles of economic design, with a form of contract and bond.

The third part takes up the critical study of an existing truss, going through all the steps described in the preceding pages and calculating weights, cost, efficiency of each member and each connection.

An appendix gives the author's full set of general specifications for steel highway bridges, in which he avails himself of the standards for various classes of highway and electric railway bridges adopted by Cooper, Schneider, the American Bridge Company and the American Railway Engineering and Maintenance of Way Association, with such modifications as are necessary to weld them all into a homogeneous and concordant document.

The relations of the bridge owner, the designing engineer, the consulting engineer, and the contractor, and of the preliminary plans on which contracts are let to the shop details, which are best left to the successful contractor under the supervision of the engineer, are clearly set forth, with statement of the common troubles which arise when the principles laid down are departed from.

ORGANIZATIONS AND INDIVIDUALS

Paving Specifications—Congress of Technology—Mechanical Engineers—Technical Meetings—Calendar—Technical Schools—Civil Service—Fred J. Cassidy—Personal Notes

The Association for Standarizing Paving Specifications.

The above name is the new title of the organization of city officials which has held two conventions for the purpose of producing standard paving specifications. The last convention was held in New York in January and the proceedings have been issued quite promptly and are now ready for distribution. They have been copyrighted and can be obtained in full only from the secretary of the association, John B. Hittell, 5917 Winthorp Ave., Chicago, Ill., at $5 a copy. The legitimate use of the specifications will be granted without charge to those who make written application to the executive committee, stating exactly what part or parts of he proceedings it is the desire to use and for what purpose. Thus any city desiring to use specifications for its paving construction work can avail itself of the work of the large number of experts in this line, who have produced after a full year of deliberation the standard specifications contained in this volume.

The two conventions held in 1910 and 1911 have reduced all the specifications almost to standard form but a third convention will be held in New Orleans January 20 to 26, 1912, according to the notice on one page and January 15 to 20, according to the notice on another page of the volume under consideration. Mr. Hittell will clear up this discrepancy and give full information about the terms of membership in the organization upon application. At this third convention some unsettled details will be further discussed and settled. But with the exception of these rather unimportant items, the specifications given in this volume are the completed standards recommended by the association.

The Congress of Technology.

The Congress of Technology which met in Boston on April 10 and 11 in celebration of the semi-centennial of the signing of the charter of the Massachusetts Institute of Technology was a pronounced success on the two main lines laid out by its projectors. The Congress opened on the afternoon of April 10 with an address by Pres. Maclaurin of the Institute on "Some Factors in the Institute's Success." The greatest of these, he said, was the method of teaching due to William Barton Rogers, the founder of the Institute, and now phrased as "the learning by doing."

The second day of the Congress was given over to the presentation of papers on various aspects of applied science. These papers were grouped in six divisions so arranged that the large numbers of the outside public which attended all the sessions were able to hear papers on the topics in which they were especially interested.

A banquet was held in Symphony Hall on the evening of April 11th when the enthusiasm of the thousand of Institute Alumni and their guests who filled the floor of the hall was a sort of summary of the impressions made by the two days' proceedings. The papers presented at the public session gave to the audiences an extraordinarily adequate idea of how completely applied science shapes and controls the living conditions of the present. And as all the papers were by alumni or members of the faculty of the Institute, it was also made clear how large a part the Institute had played in creating the applied science of today.

Among the papers which were presented were the following: "The New Profession of Economic Engineering," by Roger W. Babson, '98, President, Babson's Statistical Organization, Wellesley Hills, Mass.; "Reliability of Materials," by Walter C. Fish, '87, Manager, Lynn Works, General Electric Co., Lynn, Mass.; "The Function of Technical School Laboratories," by H. W. Hayward, '96, Ass't Prof. App. Mech., Mass. Inst. Tech., Boston; "Profitable Ethics," by David Van Alstyne, '86, Vice-President, Allis-Chalmers Co., Milwaukee, Wis.; "Technical Education and the Contracting Engineer," by Sumner B. Ely, '92, Vice-President, Chester B. Albree Iron Works Co., Allegheny, Pa.; "Sewage Disposal with Respect to Offensive Odors," by George W. Fuller, '90, Consulting Hydraulic Engineer and Sanitary Expert, New York City; "The Pollution of Streams by Manufacturing Wastes," by William S. Johnson, '89, Sanitary and Hydraulic Engineer, Boston; "Profitable and Fruitless Lines of Endeavor in Public Health Work," by Edwin O. Jordan, '88, Professor of Bacteriology, University of Chicago,

Chicago, Ill.; "Present Status of Water Purification in the United States and the Part that the Massachusetts Institute of Technology Has Played," by George C. Whipple, '89, Consulting Engineer, New York City. A number of other papers on industrial subjects were presented.

American Society of Mechanical Engineers.

The local Pittsburg committee of the American Society of Mechanical Engineers: E. M. Herr, chairman, and Elmer K. Hiles, secretary, in charge of the convention of the society which will be held May 30th to June 2nd, inclusive, has selected the Hotel Schenley as the society headquarters. In the evening of May 30 there will be an informal reception for the members and ladies.

Professional sessions will be held in the Lecture Hall of the Carnegie Institue, Wednesday morning and evening, Thursday and Friday morning. In the meantime there will be a number of inspection trips to various industrial plants in the vicinity; a boat excursion for the members and ladies up the Monongahela river, a reception and ball at the Hotel Schenley on Thursday evening, and, finally, on Friday evening a smoker and entertainment, given by the Engineers' Society of Western Pennsylvania, in their rooms, in the Oliver Building.

Technical Meetings.

The second annual Inter-State Cement, Building and Clay Products Show is to be held in the Coliseum at St. Louis on May 8th to 12th inclusive. The exhibit section will include lumber and mill work, building materials and cement and concrete in addition to the realty show.

The opening dinner of the Greater Engineers' Club of Toronto was held March 16. Capt. Kilally Gamble presided. Speeches were made by Mr. H. E. Haultain, Dean Galbraith, Dr. Ellis, Mr. C. M. Canniff, City Engineer Charles H. Rust and Mr. A. D. Macallum, city engineer of Hamilton.

The sixteenth annual convention of the National Association of Manufacturers, of which John Kirby, Jr., is president, will be held at the Waldorf-Astoria Hotel, New York, on May 15th, 16th and 17th.

The Organization of City Officials for Standarizing Paving Specifications has changed its name to Association for Standardizing Paving Specifications. Copyightred proceeding of the recent meeting held in New York in January, 1911, are now published. Information relative to membership, use of copyrighted matter and cost of proceedings will be furnished upon application to the secretary, John B. Hittell, chief engineer of streets, City Hall, Chicago.

At a regular meeting of the Municipal Engineers of the City of New York, held in the Engineering Societies Building on April 2*th, Andrew J. Provost, Jr., sanitary expert, Board of Water Supply, read a paper on the "Sanitary Problems of the Board of Water Supply."

At a regular meeting of the Brooklyn Engineers' Club held on April 13, Clyde D. Gray presented a paper entitled: "The Design, Construction and Operation of High Tension Electrical Transmission Systems." An exhibition of engineering supplies and materials was held at the club house, 117 Remsen street, during the week of April 17th.

The Third Conference on City Planning will meet this year at Philadelphia, May 15, 16, 17 and concurrently with the sessions of the conference will be held the first municipal exhibit on City Planning in the United States, for which councils have appropriated $10,000.

A meeting of the Indiana Municipal League will be held in the Masonic Temple at Crawfordsville, Ind., on June 20, 21 and 22. Among the speakers on the program as planned are the following: Professor Mason B. Thomas, dean of the Wabash college faculty; Mayor John O. Wilson, of Marion; Paul Jameson, of Newcastle; Mayor Samuel B. Spohn, of Goshen; Mayor Thomas C. Knotts, of Gary; A. E. Veneman, recent speaker of the Indiana house of representatives; Judge Timothy E. Howard, of South Bend; E. B. Stotsenburg, of Evansville; Councilman Jonas G. Howard, of Jeffersonville; Judge Lawrence Becker, of Hammond; Mayor Foster, of Anderson; Henry C. Hogan, of Ft. Wayne; Senator Robert E. Proctor, of Elkhart; Dr. E. C. Loehr, mayor of Noblesville; Mayor John Harris, of Bloomington; Mayor W. W. Zimmerman, of Richmond; Councilman Frank A. McCauley, of Huntington; Mayor Rogers, of Lebanon; Mayor Herzog, of Mishawaka; Mayor Davidson, of Princeton; Mayor Joseph D. McDowell, of Vincennes; Mayor Albert J. Field, of Bedford; J. B. Cooper, city attorney of Columbus; Finley P. Mount, city attorney of Crawsfordsville; and A. D. Cunningham, city attorney of Lafayette.

At a meeting of the New England Water Works Association held in Boston, Mass., on April 12, Mr. E. V. French, vice-president and engineer of the Arkwright Mutual Fire Insurance Company of Boston, Mass., presented a paper on "Desirable Pressure at Hydrants."

At the annual meeting of the American Society of Engineering Contractors, held in the United Engineering Society Bldg., New York City, Jan. 10, 1911, the following officers of the society were elected: W. R. Harris, president; T. Rhys Smith, 1st vice-president; V. M. Roberts, 2nd vice-president. J. R. Wemlinger and Edward Wegmann were elected respectively, secretary and treasurer.

Calendar of Technical Meetings.

National Conference on City Planning—Philadelphia, Pa., May 15-17. W. Templeton Johnson, Asst. Secy., Room 395, City Hall, Philadelphia.

Ohio Society of Mechanical Steam and Electrical Engineers.—Annual Convention, Youngstown, May 18-19. F. E. Sanborn, Secy, Ohio State University, Columbus.

National Fire Protection Association.—Annual Meeting, New York City, May 23-25. F. H. Wentworth, Secy., 87 Milk St., Boston.

National Good Roads Association.—Fourth National Good Roads Congress, Birmingham, Ala., May 23-26. J. A. Rountree, Secy., Birmingham, Ala.

National Electric Light Association.—Annual convention at New York City, May 29-June 2. T. C. Martin, Secy., 29 West 29th St., New York City.

American Society of Mechanical Engineers.—Annual convention at Pittsburg, Pa., May 30-June 2. Calvin W. Rice, Secy., 29 West 39th St., New York City.

American Water Works Association.—Annual convention at Rochester, N. Y., June 6-10. J. M. Diven, Secy., 14 George St., Charleston, S. C.

International Association of Chiefs of Police.—Eighteenth annual convention, Rochester, N. Y., June 11-16. Major Richard Sylvester, Superintendent of Police, Washington, D. C., president.

New York State Association of Chiefs of Police.—Annual convention, Rochester, N. Y., June 13-18.

American Society of Civil Engineers.—Annual convention at Chattanooga, Tenn., June 13-16. Charles W. Hunt, Secy., 220 West 57th St., New York City.

Firemen's Association of the State of New York.—Watertown, N. Y., Aug. 15-18. A. H. Otto, Secy.

American Hospital Association.—New York City, Sept. 19-22. J. N. E. Brown, M. D., Secy., Toronto General Hospital, Can.

American Society of Municipal Improvements.—Grand Rapids, Mich., Sept. 26-29. A. Prescott Folwell, Secy., 239 West Thirty-ninth St., New York City.

League of American Municipalities.—Annual convention, Atlanta, Ga., Oct. 4-6. John MacVicar, Secy., Des Moines, Ia.

Civil Service Examinations.

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

May 24—Drainage engineer in drainage investigations, office of experiment stations Department of Agriculture, at salaries of $1,000 to $2,000 a year, with promotions up to $2,500 a year.

May 24-25—Topographic draftsman at $1,000 to $1,500 a year and copyist topographic draftsman at $900 to $1,500 a year, in the various departments at Washington. Also highway engineer in the office of public roads, Department of Agriculture, at $1,440 to $1,980 a year.

June 7-8—Assistant superintendent and superintendent in the lighthouse service at $1,600 to $2,400 a year.

Fred J. Cassidy.

Fred J. Cassidy is the latest addition to the sales force of the Chicago Portland Cement Co., Chicago, Ill.

FRED J. CASSIDY.

Mr. Cassidy is 24 years of age and a native of LaSalle, adjacent to which city the mills of the Chicago Portland Cement Co. are located. His connection with his present employers dates back to early in 1907 and his training has been varied, passing through the purchasing, traffic and sales departments in turn.

The Technical Schools.

"The Strength of Oxyacetylene Welds in Steel," by Herbert L. Whittemore, has just been issued as Bulletin No. 45 of the Engineering Experiment Station of the University of Illinois. This bulletin gives the results of an extensive series of tests to determine the strength which may be developed in welded joints made by fusing thin steel plates together by means of the flames of an oxyacetylene blowpipe. Considerable information as to methods of manipulation of the oxyacetylene blowpipe and the proper regulation of the gases is also given in the bulletin.

The January issue of the Clarkson Bulletin of the Thomas S. Clarkson School of Technology contains among other articles of interest, the following: "Some Problems of the Electrical Engineer," by Henry G. Reist, engineer, General Electric Co., Schenectady, N. Y.; "The Venturi Meter as a Steam Meter," by Clarence H. Sanford, professor mechanical engineering and "Graphics in Engineering Design and Construction," by Ralph W. Rogers, professor of mechanics and drawing.

At the University of Illinois on April 7 and 8 there was held a conference of central station men, including a series of lectures. The formal part of the program included the following: "The College of Engineering and the Engineering Experiment Station," by Dean W. F. M. Goss; "Choice of Prime Movers for Central Stations," by Ernst J. Berg; "Central Station Photometry," by J. M. Bryant; "Resuscitation from Electrical Shocks, a Demonstration with and without Instruments," by R. Y. Williams; "Effect of Vacuum, Superheat and Steam Pressure on Station Economy," by Ernst J. Berg; "Cost of Street Lighting," by J. F. Bryant.

Personal Notes.

W. B. Kester has been appointed assistant engineer of the Vandalia Railroad Company at Terre Haute, Ind., to succeed H. T. Simpson, promoted.

E. W. Johnson, 2214 Rockwell St., Chicago, Ill., has succeeded K. R. Ricketts in the sales department of the Barrett Manufacturing Co. of that city.

E. C. Crum, of the firm of Crum & Davidson, engineers, Frederick, Md., has been appointed city engineer of that city. Mr. Crum is engineer for the county. He will also continue his interest in the firm.

James L. Tighe, for nineteen years city engineer and engineer of the municipal water works in Holyoke, Mass., has opened an office in the Caledonian Bldg., Holyoke, Mass., for the practice of hydraulic and municipal engineering.

Mr. Godfrey Sperling, following his absence the past season, has taken up anew his civil engineering and surveying practice at 401 Overland Bldg., Boise, Idaho.

W. P. Bushnell was elected city engineer of Quincy, Ill., by 1,500 majority over F. L. Hancock.

Mayor Emil Seidel, of Milwaukee, recently made the following appointment: Harry E. Briggs, salary $5,000 as city engineer to succeed Charles J. Poetsch, whose term expired; Joseph A. Mesiroff, salary $4,000 as water registrar to succeed John Lemanski.

J. G. Rossman, of New York, has been appointed manager of the Winnipeg municipal power business at a salary of $6,000 a year. Power from the plant will be ready for delivery next July and this will undoubtedly do much to increase the industrial growth of the city.

Maughmer & Nickerson, civil and Hydraulic engineers, have opened an office at Sacramento, California, for the practice of engineering, giving special attention to water works systems, irrigation works, hydro-electric power plants, sewer systems, reclamation work and serving as consulting engineers.

Walter C. Parmley, member American Society Civil Engineers, Everett Bldg., E. 17th street, New York City, and Edgar S. Nethercut, member American Society Civil Engineers, Monadnock Bldg., Chicago, Ill., have formed a consulting firm to be known as Parmley & Nethercut. Both members will retain their present offices. The firm will handle reinforced concrete sewers and other structures.

Frank M. Blaisdell, architect and landscape engineer, First National Bank Bldg., Fort Smith, Ark., has established branch offices at 917 and 918 Southern Trust Bldg., Little Rock, Ark. Mr. Blaisdell is prepared to act as architect and engineer for private municipal and corporation building and grounds of all descriptions and invites manufacturers and others to send him catalogs and other literature of interest, addressing the Little Rock office.

A. B. Alderson and A. S. Brainard have established an office for the practice of civil engineering and surveying in the Phoenix Mutual Building, 49 Pearl St., Hartford, Conn. Special attention will be given to town engineering, including resurveys of town boundaries, highway surveys and maps, establishment of street and building lines, real estate surveys, maps and sub-divisions, the development and installation of sewer systems and sewage disposal plants, together with plans, estimates and specifications for general construction work.

M. D. Burke and W. M. Venable, members American Society of Civil Engineers, have entered into a partnership under the firm name of Burke & Venable, as consulting engineers, with office at Room 706, Second National Bank Bldg., S. E. Corner Ninth and Main streets, Cincinnati, Ohio. In addition to the surveying and development of real estate, planning and supervising the construction of streets, sewers, water supplies, drainage and similar engineering work commonly executed in connection with the improvement of property and of public works, the firm will give special attention to sewage and refuse disposal, hydraulics and reinforced concrete construction.

Portland Cement Manufacturers.

The little annual list of the companies manufacturing Portland cement, published by the Cement Era, Chicago, has been issued for 1911. It includes names of principal officers, capitalization, capacity, process, number of kilns, names of brands, etc., for plants in operation, under construction and in the promotion stage. There are 158 companies in the list. The book also contains alphabetical lists of the superintendents and chemists of the cement companies, the brands of cement on the market, companies manufacturing gypsum, in the same form as the Portland cement list; and a list of companies manufacturing lime, arranged alphabetically under the states in which they are located. The list is in convenient leather-bound pocketbook form, and is sold for $1.

MACHINERY AND TRADE

An Effective Weed Destroyer.

There has been on the market for a number of years, a chemical known as the Atlas Preservative A. This chemical has been extensively used for the purpose of impregnating wood to insure it against decay and the attack of insects. Its value for other purposes has recently been demonstrated. In nearly all the municipalities of the country, there has been considerable work involved in keeping the streets of the outlying districts free from weeds. These streets upon which the travel is not heavy are a source of a great deal of expense, under the usual method of removing the growth of weeds by hand. It has been found that the Atlas Preservative A can be used to much better advantage and a great saving for this purpose. Some of the leading real estate firms of New York City have been making use of the chemical to prevent weed growths on the streets of new additions. tI has been found to be from 50 to 90 per cent cheaper than the methods formerly employed. One application of the chemical has usually been found sufficient to hinder growth for one season. This one application can be made at a cost of about 75 cents per thousand square feet of area. If the chemical is used for two or three seasons in succession the soil is rendered entirely sterile and no further trouble is experienced.

The application of the chemical is made with the ordinary sprinkling cart by means of which material after being diluted is sprayed upon the surface to be treated under the same conditions as in ordinary sprinkling. The preservative is supplied in a concentrated form in six gallon drums, and three or four of these drums are sufficient to make about 600 gallons of solution depending upon the strength of solution deemed necessary. By reason of the simplicity of its application, the preservative may be used by the laborers ordinarily employed in street department workk.

In one of the largest municipalities in the state of New York several miles were treated last season at a cost of ¾ cents per yard including all items and labor of application. Previous to this time, the work had been accomplished by hand-labor (scrapers being used) at an average cost of 2¼ cents per square yard. In some places where a second scraping had been found necessary, the cost of weed prevention for one season was 4½ cents per square yard as compared to ¾ cents per square yard for Atlas Preservative A. In addition to this fact, the chemical not only killed the upper growth of weeds, but destroyed the roots and after a time rendered the soil entirely sterile. It is used by many railroads in removing the growth of weeds from their tracks, acting without the loss of ballast and other bad features attendant upon the usual method of pulling the weeds.

It is also used extensively, particularly on the railroads of India as a wood preservative. The method of treating is extremely simple, the wood being immersed in proper solution which is usually heated to about 150 degrees. This heating is not necessary in all cases, though better results are obtained by this process. The preservative hardens and strengthens the wood fibers, permeating their structure and driving out the green sap. It seasons without staining and renders the wood less inflammable and secure against the attacks of insects. Used in conjunction with coal tar it is an efficient substitute for creosoting.

The principal use which recommends it to the attention of municipalities is that property which makes it of value in the destruction of weeds. One drum of the concentrated solution is sufficient for one application over an area of 400 square yards. The strength of the solution is varied according to the absorptive power of the surface; the minimum being one gallon to fifteen gallons of water. Hard gravel may require a proportion of one gallon of solution to five gallons of water. Where the eradication of existing weeds is desired the application of a strong solution directly on them is recommended. Periodical use will result in the entire sterilization of the soil.

The chemical is manufactured by the Atlas Preservative Co. of America, 97 Liberty Street, New York City.

The Case Road Machinery.

Six years ago the J. I. Case Threshing Machine Co. put on the market their power steered 10-ton steam road roller which was then the only power steered roller on the market. Since then it has grown into favor throughout the country.

This year the company decided to put forth a line of machinery for road uuilding almost complete. In addition to the road roller and road sprinkling wagons

they have been selling, they have added drags; rock crushers; rotary stone screens; rooters; road scrapers; railroad and township plows; the Troy line of bottom dump wagons and boxes; the Troy reversible bottom dump wagons, and the Case municipal tractors.

The latter are especially constructed for use on any kind of paved streets; and Case contractors' hauling engines, which complete the line. It can be readily seen that it is "almost complete" for road building

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Data on Decorative Street Lighting.

"The Illumination of the Streets" is the title of a publication just issued by the Holophane Company. While intended for popular distribution rather than for engineers, the booklet contains some valuable data on the subject and should be appreciated by all who are interested in the so-called "boulevard lighting" installations.

The Holophane Company's street lighting units have several definite advantages, according to the data given. The units are the result of a long series of investigations and experiments by the Holophane engineers, and are designed to give the maximum of even illumination upon the streets and sidewalks with the minimum of objectionable glare. The comparative ,photometric curves published would indicate that the units are successful in both directions.

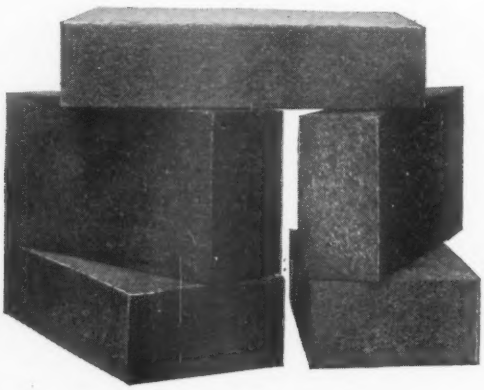
Artistic appearance, however, has not in this case been sacrificed to engineering considerations. The Holophane units are attractive and the various designs have a wide range of adaptability. A sketch of a lantern for residential districts strikes a new note in street lighting equipment.

A description of the Holophane installation in Cincinnati, Ohio, appeared in the March issue of MUNICIPAL ENGINEERING.

Cork Brick.

A material especially adapted for use in floors of fire stations, approach driveways, etc., has recently been patented by the Armstrong Cork Co., of Pittsburg, Pa. This material known as Cork Brick consists of finely granulated cork and an especial grade of tough asphalt, heated and thoroughly mixed and pressed into the form of bricks. These bricks, shown in the accompanying photograph, measure 9 inches by 4 inches by 2 inches and laid flat. A number of experiments were carried on to determine the proper grade and proportion of asphalt necessary in making the brick, and the product as now manufactured fully meets the expectations of the manufacturers.

The material gives a thoroughly sanitary, non-absorbent floor, especially adapted to use in fire department buildings, both in stables and engine rooms. As is shown by the fact that the brick will absorb less than 1½ per cent. when immersed in water, they are well adapted to the flooring of stables. The property of nonslipperiness makes them desirable in the engine room. It has been found that regardless of whether they are wet or dry, the friction property remains the same.



CORK BRICK.

The brick have been tested in actual service and found to outlast most of the flooring materials. The special grade of asphalt used seems to add to this property of toughness or durability. The brick will not crack nor splinter.

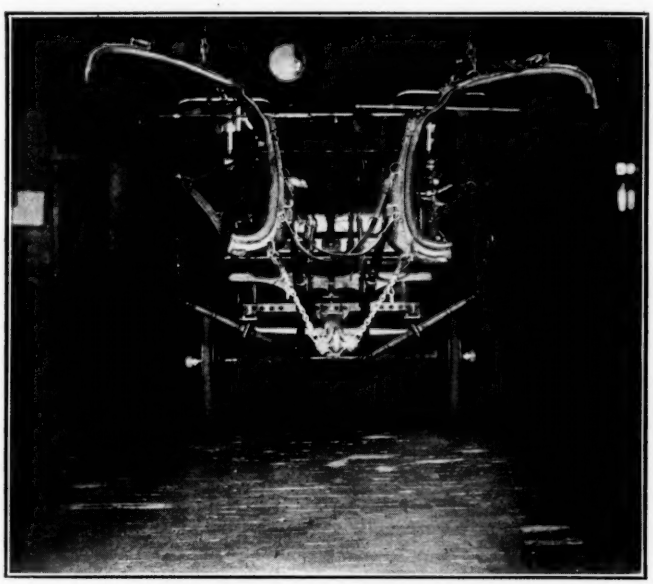
They may be laid on any sort of smooth, sound foundation, concrete, broken stone or wood. If laid on concrete, the brick may be laid in three ways, viz; in Portland cement mortar, in a thin layer of hot asphalt or pitch, or in a bed of sand. When laid in asphalt or pitch, the surface of the concrete should first be given a light coat of asphalt paint. Over a broken stone base, the brick are put down on

a bed of sand; over wood, in hot asphalt or pitch.

The accompanying photograph shows a floor of a fire station which has been in service for about a year.

Confidential Trade Notes.

Amos Stouffer, of Wayneboro, Pa., has recently copyrighted a book known as "Confidential Trade Notes" which is devoted to a description of the best practice in the use of concrete. Mr. Stouffer is a man who has used cement in almost all of its forms throughout a lifetime. His work has been principally along the line of experiment and research; the results of this work being included in the book above mentioned.



CORK BRICK FLOOR IN FIRE STATION.

In speaking of the use of concrete, Mr. Stouffer states that it has been remarkable in the growth and volume of manufactured products in blocks and other forms which have been made; and also for the very meager profit accruing to those who manufacture such products. He accounts for this fact by the statement that the method of manufacturing has not been of the best; and the keen local competition has been made in the form of cheap brick, stone and monolithic concrete.

It has been the purpose of the book to set forth the methods to be followed in bringing concrete blocks to a superiority over these building materials. Under the new methods, a wheelbarrow load of concrete in its higher form carries an increased profit over the older and cruder methods. The new field offers a wide market and uses for concrete art products and provides for their disposal at profitabel prices. The uses of concrete in interior decoration and other ornamental purposes is given as the solution of the problem of the future of concrete. It is stated that no other material offers itself so readily to tasteful design and artistic results.

Among the subjects treated in "Confidential Trade Notes" are the following: prevention of crazing or map cracks; new methods of water proofing; improvements in rock face blocks; artistic art methods in rock face blocks; new matrix method in rock face blocks; sand finishes, stucco, etc.; pebble dash and wall plaster, etc.; concrete marble, art marble; a concrete plant in itself—entirely new; white Portland cement—new possibilities; cement letters, figures, signs, etc.; highway advertising signs, etc.; polished concrete marble, without friction; steam vapor curing of concrete; steam under pressure for concrete; polishing of concrete; marbleized concrete; and a number of other valuable uses.

Full information regarding the book may be obtained upon application to the Art Stone Co., postoffice, box 333, Waynesboro, Pa.

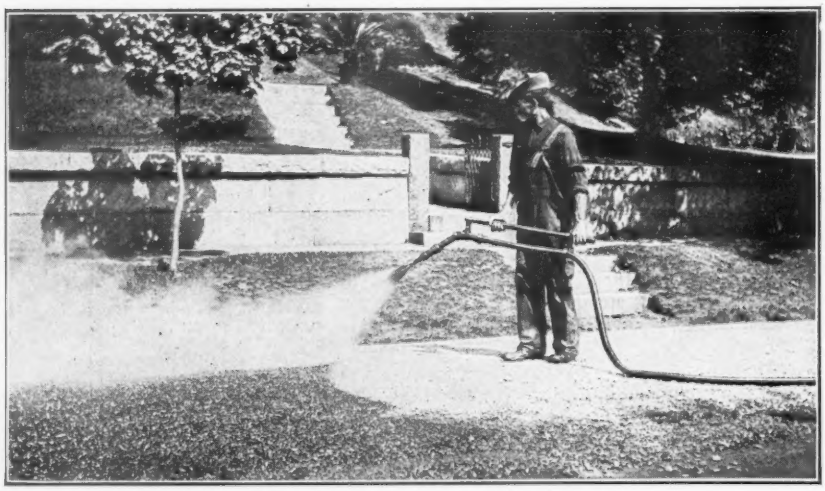
Reinforced Concrete Automobile Factory.

The Lozier Motor Company of Detroit, Mich., have recently completed one of the most complete automobile factories in the world. The buildings are of the Turner steel and concrete flat slab type with

mushroom columns. Buildings were designed by Albert Kahn and constructed under his supervision. They are absolutely fireproof and the contents protected by automatic sprinkler, fire doors, and other devices of this nature. Fenestra glass is used for lighting. The ventilatinging, heating and blower systems are of the latest type. Special features in sanitation contained in this plant, are to be found in no other. The power plant is most complete, comprising boilers with automatic stokers, large Allis Chalmers generator, Laidlaw Dunn-Gordon air compressors, and other machinery of this character.

In 1906 in Somerville, Massachusetts, the experiment was tried of bonding the top layer of 1¼ inch stone in a macadam road with Tarvia. The Tarvia was sprayed onto the road hot from a tank wagon, in a single coat of 1½ gallons to the square yard. The Tarvia was covered with pea stone and the road rolled until solid. This first and now classic experiment was a forerunnner of what is now known as the penetration method of bituminous macadam road construction.

The form of construction and the method of applying the materials must necessarily be varied to suit local conditions. In striving to meet the exacting require-



SPRAYING TARVIA X ON THE BROKEN STONE AS A BINDER.

The Tarvia Modern Pavement.

The experience of the last few years has demonstrated to road engineers that a turning point has been reached in the problem of maintaining macadam roads against the disintegrating forces of modern traffic.

When the destructive action of the automobile tires was first observed, surface applications of bituminous binder were believed to be all that was necessary. Experience has shown, however, while surface treatments, cost considered, give good results, it is more satisfactory and economical to construct the road throughout with a bituminous binder.

In Tarvia, a prepared coal tar of great tenacity and viscosity, engineers have found a bituminous binder which has given good results.

This material has been in use in various places on this continent for about six years. The only questions now discussed are the details involved in the reduction of the cost of Tarvia treatments.

ments of the broad radiating thoroughfares extending out from the metropolitan centers a new form of construction has been developed during the past two years to which the name of "The Tarvia Modern Pavement" has been given.

In this construction Tarvia enters not only into the top surface of the road, but is carried down beneath the top course. Coupled with the use of Tarvia throughout the road is the use of larger stone in the second course. Experiments with this form of construction through the past two years have shown its superiority over other forms where a considerable amount of traffic of all descriptions is to be carried on the road.

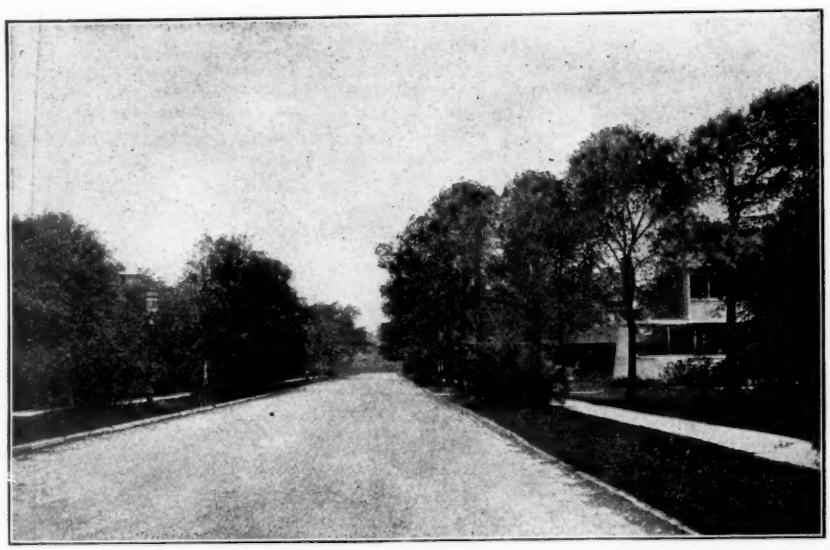
The foundation of The Tarvia Modern Pavement is prepared as for ordinary macadam, but care should be taken to see that this foundation is properly drained and properly consolidated, for the best of surfaces can be destroyed by softness and movement below. Upon the foundation the base course is laid using run of

crusher stone 3 inches to 1 inch in size. Usually a thickness of four inches, measured after rolling, will be sufficient. This course is filled, rolled as for ordinary macadam and then has spread upon it ½ inch of clean sharp sand or good gravel. Over this without further rolling is sprayed Tarvia A to the amount of one gallon to a square yard. Another layer of crusher stone (3 to 1 inch) is spread over the Tarvia A to such a depth that when rolled this course will be two and one-half inches thick. It is then rolled thoroughly with a steam roller until the Tarvia and sand are drawn up between the stone and until this layer of stone is bedded firmly into the stone below. The

The first of the accompanying photographs shows the method of applying the binder.

The use of large stone throughout the road and in the surface layer insures a structural strength not obtainable with smaller sizes of stone. This strength-giving principle has long been recognized abroad, but with a water bound macadam it was not possible to use this form of construction satisfactorily. The anchoring-in of the stone in the wearing course by the sand Tarvia matrix, now makes the use of the larger stone feasible.

The increased strength and wearing qualities of the larger stone are presented to the best advantage since the stones are



HAZEL AVENUE, CHICAGO, MADE DUSTLESS WITH TARVIA.

layer of Tarvia and sand holds this course firmly in place and cements the top course of the road thoroughly to the bottom course. A spraying of Tarvia X, a denser grade of Tarvia, is then given to the road, using one and one-quarter gallons to a square yard, and a thin layer of ¾ inch stone is spread over the surface. Enough stone must be used to fill in all the chinks of the surface, making it smooth, but not enough should be used to leave any loose material on the top. The road is rolled again until perfectly smooth and a final coat of Tarvia A amounting to one-half gallon to the square yard is sprayed on and the road finished by adding pea stone or screenings and given a final rolling.

The thorough incorporation of the Tarvia throughout the road insures the binding of every part and the elimination of the internal friction which is so destructive to macadam roads.

held firmly in place with no chance of movement and with the wear taken alone on the upper surface.

The Tarvia Modern Pavement, like other forms of Tarvia construction, is inexpensive compared with the other forms of bituminous construction. An engineer, by properly designing the road can often save enough in stone, in watering, in screenings, and in rolling, to offset much of the cost of the Tarvia.

The second photograph shows a finished roadway laid on Hazel avenue, Chicago, Tarvia being used as a binder.

The Russell Road Building Machines.

The Russell Grader Manufacturing Co., of 2233 University Ave., South East, Minneapolis, Minn., have a catalogue descriptive of a complete line of road machinery which they manufacture. Among the ma-

chines shown, there is a "township size" elevating grader operated by six horses.

The feature of this machine is the carrier or elevator (a belt 36 inches wide) which conveys the dirt from the plow to the place desired. This elevator is operated by gasoline engine. As the machine does not depend on drive wheels for its tractive power there is no danger from slipping, and it may be used in loose or very wet dirt. This feature is also of value in using the machine in sand or gumbo soil. The grader is capable of moving from 1,000 to 1,200 cubic yards of earth per ten hours of actual work; and in some cases 2,000 yards have been handled in this interval. The operating expense is comparatively low as only two men are employed in loading wagons, two to handle the plow and another the carrier.

This is only one of the many types of machines shown in this catalogue. There are other graders some power driven; and in addition to this, there are shown ditching machines and the ordinary type of road graders.

In addition to these there are road drags of various types; slips; wheelers; tongued scrapers, and plows.

The catalogue is worthy of attention from those interested in road construction, as almost all apparatus required in road work is shown.

North Yakima Adopts Bitulithic.

The following is from a report of the council committee from North Yakima, Wash., who investigated paving in some of the northwestern cities a few weeks ago:

We find that the pavement required for city streets should have the following essential qualities: durability, noiselessness, cleanliness, non-slipperiness, cheapness, which must be figured by the rule, the ultimate cost of a pavement is first cost plus maintenance.

Being quite familiar with brick and asphalt, having laid 48,000 square yards of asphalt, and 71,200 square yards of brick in our own city, we devoted a major portion of our time to other materials in use.

After spending three days looking over the pavements in Seattle and Tacoma, which are paved with brick, asphalt, wood block and stone block, we visited the city of Puyallup where bitulithic pavements are being laid exclusively. Here about five miles of bitulithic pavements are laid, and the contractors were in process of constructing other streets with the same material. Upon being invited to procure a sample, we selected a place and a sample was cut out in our presence which was replaced to our satisfaction, the idea being to demonstrate to us the ease and perfection with which it can be repaired, and when finished the place could not be found again where the patch was made. As these pacements were but recently completed, and the oldest street laid was only one year old, we could not draw a definite conclusion as to its durability. We therefore proceeded to Portland, Oregon, where there are 54 miles of bitulithic pavement laid, the oldest being laid in 1903. The streets of Portland are exceedingly narrow. On some of the principal streets there is but room enough between the car track and the curb for one vehicle, thus subjecting the pavement to the severest test possible. Bitulithic pavements which were laid in 1903 are still in good condition. Mr. Morris, city engineer of Portland, informed us that there is not a crack in the bitulithic pavement in Portland, and we can corroborate the statement as far as we were abel to ascertain.

Bitulithic is easily maintained, it being at a nominal cost, to resurface or build up a depression with a perfect bond between the original surface and the portion added—thus demonstrating that the remaining portion of pavement, after wearing for a period of time has inherent binding qualities, thus proving that the old portion is of value in making repairs and that it is not necessary to remove the old pavement should it become necessary to resurface, while to resurface asphalt it is necessary to remove top and binder. Some of Portland's steeper grades are paved with bitulithic.

A Portable Machine for Making Compression Tests.

Compression tests on such building materials as concrete, rock, and brick, in fact any material used for resisting compressive stresses only are obviously far more important to the designing engineer than a knowledge of the results of their tensile strength. Cement specifications at present require only that tensile tests be made on briquettes of neat cement, a mixture of one part cement and three parts sand.

Compression tests are not required in specifications because of the great weight and cost of the common type of compression testing machines and the difficulties connected with carrying such a machine around from place to place. Tension testing machines are comparatively light and can be made so because cement is weak in tension and no great force is necessary to rupture a briquette. Heretofore there has been no simple, satisfactory compression testing machine on the market.

Concrete is a material that cannot be tested too frequently in compression. Being constantly proportioned and mixed by men who have no knowledge of the properties of the mix, very close supervision is necessary. To know positively that concrete has the necessary strength to stand up under its load and not collapse before the building, chimney or foundation wall is complete, as has so frequently happened and is still happening daily, should be a great load off the minds of the designing and constructing engineers. It was this condition of affairs that suggested to The Watson-Stillman Co., N. Y., the building of a hydraulic compression machine that would comply with the demands of men on the job as well as the demands of laboratories.

This new machine, which we illustrate, is of a common type of hydraulic press

and weighs only 425 lbs. as compared with 3,400 lbs., the weight of material necessary to build the common beam type of machines of equal capacity. The base measures 12 inches by 16 inches and the press is 27 inches high. The cylinder is a steel forging machined to fit down into the reservoir, and the pump cylinder is of bronze. This type of testing machine can be carted from place to place on a truck and is also superior to the ordinary compression machines in that all observations can be made by the operator of the pump. He can watch the compression specimen, the pressure gauge, and handle the pump simultaneously. This permits rapid work and no waste of time. The operator can also apply the load as rapidly or as slowly as he wishes by corresponding manipulation of the lever. The gauge is graduated to give both the fluid pressure in pounds per square inch and the pressure of the ram on the specimen in tons. A feature of the machine is the ease and quickness with which the ram can be moved to and from the work by means of the lever and connecting links at the left. The small handle at the right furnishes sufficient power where only light pressures are required, while the extension lever applied to this same arm, develops pressures up to 30 tons. The platen face is 8 inches square; the platens are 8 inches apart at maximum opening and the ram movement is 4 inches. The machine will, therefore, accommodate compression cubes or cylinders varying from 4 inches to 8 inches. The size to be tested must be left to the discretion of the testing engineer as it depends upon his estimate of the strength of the mix. A 4-inch cube would have to hold 3,750 lbs. per sq. in. under a load of 30 tons, but as that figure is higher than most mixes will hold, 3 in. cube might be a satisfactory size for all mixes.

Fireproof Roofing.

Over a million times during the past ten years we have witnessed the thrilling sight of burning buildings. Last year $204,000,000.00 worth of property was destroyed by fire. In the search for practical methods of lessening the danger of ignition and spread of flames, tile, vitrified facings, terra cotta, concrete construction and numerous other fire-resisting materials have been developed for use in all parts of buildings except the roof, while but few important improvements have been made in roofing materials, notwithstanding the fact that authorities claim that from 27 per cent. to 50 per cent. of the conflagrations are the result of flames being communicated to adjoining buildings by burning sparks and embers falling on an inflammable roof.

Factories, barns, etc., are probably more at the mercy of burning sparks and embers than other types of buildings, because they are usually covered with so-called ready roofings, and nearly all roofings of this type are made of wool felt, rag stock, paper, coal tar and other highly inflammable materials. There is one roofing of this type, known as J-M Asbestos Roofing, which is being largely used on factories and large buildings, which seems to overcome the objections to all others of this type. It is said to be so fireproof that it will withstand the flame of a blow-torch for an hour without being injured. This roofing is made by the H. W. Johns-Manville Co., of New York, well known as manufacturers of asbestos products.

This roofing is made of asbestos (a stone) and Trinidad Lake Asphalt (a mineral).

The asbestos rock, when scientifically crushed, produces long, tough fibres which are woven into cloth for asbestos theater curtains, made into sheets of felt for roofing, and treated in various ways for making hundreds of different fireproofing materials.

In making this roofing, several sheets of this asbestos felt are thoroughly saturated with Trinidad Lake asphalt, a waterproofing material. These sheets are then cemented firmly together with this asphalt, making one homogenous mass. This, then, constitutes an actual covering of stone, which, because of its all-mineral nature, not only offers to a building protection against fire, water, wind and weather, but which also naturally cannot rot, rust, melt, run or crack, and requires no painting to preserve it.

A copy of the very handsomely illustrated catalog, which we received from the manufacturers, will, no doubt, gladly be sent to any of our readers inquiring for it.

The Heltzel Steel Sidewalk Forms.

The development of methods in connection with concrete sidewalk work has ben noticeably slow. The old, original processes and methods have been unchanged since concrete walks were first built. This has been particularly true in the case of forms, which have been of the old wood and stake system from the start. The Heltzel forms manufactured by the Jones & Heltzel Co., 115 South Sterling St., Streator, Ill., are a notable advancement over the old methods of construction. They consist of adjustable steel sections so made as to be readily adapted to almost any line desired. The side rails, which correspond to the wooden strips used in the old method, are of annealed steel, provided with division plates set at intervals of one foot. These rails are joined by adjustable sleeves made larger in section to provide a free slipping engagement with the side rails. These sleeves are made of varying lengths as needed.

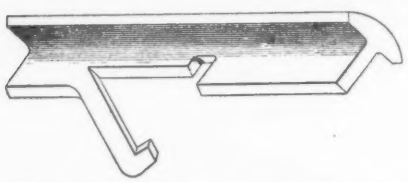
The forms are held in place by division plates of high carbon steel, which slot into the side rails, holding them rigidly into position. These division plates are removed by means of small hooks which pry them loose from the side plates and allow them to be easily lifted.

The forms may be easily adapted to any angle, and suitable curves are provided according to specific conditions desired. The method of joining these grooves and angles admits of an even surface along the entire edge of the walk.

In addition to these forms, the Jones-Heltzel Co., manufacture a steel curb and gutter form which is distinctive in its method of operation, requiring no clamps, stakes, nor wedges. Their forms and concrete tools are shown in their catalogues which will be sent upon application.

Imperial Curb Bar Reinforcing.

It has been acknowledge for some time that some reinforcing on the wearing surface of concrete curb is necessary. The ordinary forms of reinforcement have been on the market for a number of years and have been giving very good satisfaction. There has, however, been recently invented a form of curb bar which possesses features of superiority over previous forms as regards method of attaching it to the curb.



The accompanying photograph shows the Imperial Curb Reinforcing Bar, manufactured by Edward E. Buhler Co., 103 Park Ave., New York Ciay. The distinctive feature as may be noted is the fact that the center web is sheared in such a manner as to give a hook or lug which may be firmly imbedded in the concrete. This factor gives additional security against loosening of the bar and the chipping of the curb surface.

The bars are manufactured in seven foot lengths, it being deemed advisable to adopt this length, although ten foot bars were formely supplied. There are, at present, two sizes manufactured, but differing specifications demanded by engineers of various cities have made it necessary to manufacture four sizes. The bar is galvanized by a new process which gives a surface to which the cement adheres firmly. About 12,000 feet of the bar make a car load.

Other metal accessories used in cement work, such as ditch protectors for railroad platforms, cross walks, and columns; separators, to be used between sections of curb; and benders for reinforcing bars are manufactured by this company.

Test of Decarie Garbage and Refuse Incinerator.

The official test of the Decarie incinerator reecntly built at Wheeling, W. Va., to determine the ability of the furnace to consume 60 tons of garbage—its rated capacity—in 24 hours, was begun at 10 o'clock on Jan. 6, 1911. The last ounce of the 60 tons accumulated for the test had been reduced to ashes on Friday morning at 3:45, a period of 15 hours and 45 minutes. The furnace thus had 8 hours and 15 minutes to spare. The furnace was in charge of F. W. Cappelen, chief engineer for the Decarie company, and the test was witnessed throughout by the city health commissioner.

Basic Bitulithic Patent Sustained by U. S. Circuit Court of Appeals.

The decision of Judge A. C. Coxe, of the U. S. Circuit Court of the Southern District of New York, which was reported on p. 64 of the January number of MUNICIPAL ENGINEERING, has been fully sustained by the U. S. Circuit Court of Appeals of the Second Circuit. The validity of the basic patents on bitulithic pavement was attacked in the suit, but was affirmed by Judge Coxe and his decision is now sustained upon appeal.

Calcium Chloride as a Dust Layer.

Calcium chloride is used for dust laying purposes in two ways: First, by dissolving in water and applying with an ordinary sprinkling cart; second, by spreading it directly on the road in its dry granular form, containing 75 per cent. calcium chloride, and allowing it to dissolve by absorbing water from the air. Both methods have proven successful.

Where the expense of water is not an essential element, and there is already a sprinkling plant, the first method may be used successfully and economically. All that is necessary is to first dissolve the calcium chloride in the watering cart at the rate of 1 lb. to 1½ lbs. of calcium chloride for a gallon of water, and, as the material itself is the only additional expense, and as a treatment will last two or three weeks, the reduced cost of application more than makes up for the cost of the calcium chloride. This method of application has been used for some years by such communities as Brookline, Mass., Pittsfield, Mass., Albany, N. Y., etc., and has been found to lay the dust effectually.

This method has also been used with complete success on race courses and driveways. The New York State Fair Commission have for the last three years treated their track at Syracuse with a solution of calcium chloride, and have not only rendered it dustless, but have thereby made it one of the fastest tracks in the country. At the race meet at this fair in 1910, three world's records were broken; two automobile records by Ralph De

Palma, and one by the horse "Harvester."

The second method, which is applying the calcium chloride in its dry granular form direct to the road, and allowing it to dissolve by absorption of water from the air, is more satisfactory in all cases except in the immediate vicinity of towns or cities, where water is easily available. Even in many of these cases, it has been found more satisfactory. One pound of the 75 per cent. granulated calcium chloride applied in this manner will attract and retain from the atmosphere 1 to 1¼ lbs. of water. This keeps the road in a firm, moist condition, but without the formation of mud.

The city of Duluth, Minn., found last year that one application of 1 lb. to the square yard lasted nearly the whole season, thoroughly laying the dust and preserving the road surfaces.

The best results are obtained by applying at the rate of 1½ lbs. to the square yard, though in some cases a smaller application is sufficient. Generally, three applications per season are required, though this will depend somewhat on weather and traffic conditions. As mentioned above, the first application should be 1½ lbs. to the square yard, but the succeeding applications may be lighter, there always being a certain per cent. of the calcium chloride retained by the soil, though in itself it may not be sufficient to lay the dust.

The New York State Highway Commission have also used granulated calcium chloride to a large extent during the last year in the maintenance department, with most satisfactory results. By the dry method, the medium of application is an ordinary land lime spreader, and four men with one of these machines will readily cover five miles of a 16-foot road a day, thus reducing the cost of application to a minimum. The state officials figure a cost of about $150.00 to a mile of 12-ft. road per season, this varying slightly with the location.

The Solvay Process Co. of Syracuse, N. Y., supply calcium chloride in its granulated form, suitable for applying by the second method. The accompanying photograph shows a road in Detroit, Mich., treated by this process.

"CALCIDE" ROAD, DETROIT, MICH.

Charter Gas and Gasoline Engines.

An improved type of gasoline engine manufactured by Charter Gas Engine Co., 911 Wallace St., Sterling, Ill., recommends itself to contractors' use by reason of its simplicity of design, and small number of working parts which are exposed to wear and the destructive effects of heavy service.

The principle of operation in the development of power in this engine differs but little from the ordinary type of gas or gasoline engine. On the first stroke of the engine a mixture of gas and air is drawn through a check-valve into the cylinder; this check-valve opens during the second stroke and is closed again during the in-stroke and is ignited in mixture is compressed into the space between the cylinder head and the piston during the in-stroke; and is ignited in the ordinary way by means of a spark from the battery or magneto. The mixture is expanded, giving an impulse to the piston. When the piston has reached its second out-stroke, an exhaust valve is opened, remaining open during the sec-

ond in-stroke of the piston, and the products of combustion are expelled into the muffler.

The engine uses gasoline direct from the tank, taking it into the air suction pipe without any other complication and never coming into contact with the air except in the suction pipe and cylinder of the engine. The supply of gasoline is automatically regulated and varies with the speed of the engine.

Various types of enginees are furnished depending upon the substance used to furnish power, that is to say, gas, kerosene, petrol, distillate, naphtha or alcohol. The type of engine which recommends itself to the contractors' use is the gasoline engine.

Various pumping equipments and hoists are furnished as desired, some portable outfits being included in the types manufactured.

The economy of the engine is one feature which will recommend it to the contractors' use. The gasoline engine uses about one pint of gasoline per hour to each actual horse power. All of the gasoline is utilized. The horse power stated is in all cases the actual horse power which may be obtained, as it is the policy of the company not to overrate their engines. The material and workmanship are guaranteed throughout, the best of metal and the most careful construction being insisted upon. A catalogue and full information will be furnished upon application to the manufacturers.

Fire Test of Corinthian Standards.

On the night of March 5th there appeared in Minneapolis, a fire which in its intensity and destructive effect far exceeded anything which that city has known, not excepting the recent explosion and fire in the Power Plant which was so crippling in its destruction. The fire devastated the south of Nicollet avenue for one block, and wrought a total property damage estimated by insurance men and Nicollet avenue business men at from $1,100,000 to $1,300,000. The entire Syndicate building was ruined and adjacent buildings were attacked by the flames, which were driven by a high south wind in such a manner that at times they extended entirely across the street. Sparks and embers were carried across, destroying the awnings and frames of adjacent buildings and except for the fact that most of them were of fireproof construction, there is no doubt but that the entire business section of the city would have been destroyed.

One remarkable fact in connection with this fire is that the ornamental lighting standards which stand along the street

CORINTHIAN STANDARDS IN MINNEAPOLIS FIRE.

in front of the Syndicate building, although exposed to most intense heat, and in fact surrounded by flames at times during the fire, were not in any way damaged. The accompanying photograph indicates the position of these standards with reference to the burning building. The light effect coming from the building represents the flames, which were so intense that the firemen were unable to approach closer than thirty feet distant. As shown, streams of water were kept playing in close proximity to the stanards, which were red hot from the intense heat. In spite of this fact, there was no evidence of cracking or warping, such as would be expected under the conditions. These facts evidence the superiority in the casting of the posts and the high quality of metal used in their construction. A better test could not have been planned than that which the Syndicate fire afforded. The standards were the "Corinthian"

type, manufactured by the Flour City Ornamental Iron Works, Minneapolis, Minn.

An Unusual Booklet.

One of the most unique publications issued during the past month is that known as "An Important Trial," which is being distributed by the Dunn Wire-Cut-Lug Brick Company, of Conneaut, Ohio. The question is stated as a matter before a jury, and the purport of it is:

"Shall we continue to require manufacturers to re-form wire-cut bricks by puting them through a stamping machine and call them repressed brick, or shall we permit them to cut lugs while cutting the original brick and thus preserve the original formation?"

The points in favor of wire cut brick are offered as testimony in the case. A list of cities which have admitted the wire cut brick to their specification is given in the back part of the publication.

Commendation for Sieben Sewer Cleaner.

Letters over the signatures of the mayor of Kansas City, Mo., J. E. Porter, and Wm. M. Clancy, supt. of sewer cleaning and repairs, testify to the efficiency of the Sieben system of sanitation sewer cleaning device.

In speaking of the operation of the machine, Mr. Clancy says

On Ashland avenue sewer we operated the machine, cleaning a distance of 380 feet after the machine was set in the sewer in twenty-four (24) minutes. This sewer was about 1-3 full, a 15 inch pipe sewer.

The test given the machine on 2nd street, in an 18-inch pipe sewer was full within 6 inches of the top. We cleaned 280 feet in forty-four (44) minutes. On 2nd street, in a 15-inch pipe sewer we cleaned 300 feet in thirty-six (36) minutes. This sewer was very badly congested, only about 4 inches of an opening in the top of the sewer.

Mr. Porter in his letter, tells of the cleaning of 400 feet of sewer at a cost of $9.00, including the time of three laborers and one man with a wagon. Both officials agree in their opinion of the efficiency of the machine.

A complete account of the tests may be had from the Sieben System of Sanitation Co., Kansas City, Mo.

Trade Publications.

The Atlas Dryer Co., of Cleveland, O., have a catalog called "A Thesis on the Use of Drying." Photographs and sections of their machines are shown.

The Chicago Portland Cement Co., 108 La Salle St., Chicago, have issued a handsome illustrated book descriptive of structures erected with their product, the "Chicago AA" Portland Cement. Almost every form of construction involving cement is shown.

The April issue of the Bulletin of the Universal Portland Cement Co., 72 West Adams St., Chicago, contains among other articles of interest, photographs of slab bridge construction of New York state roads, concrete mine timbering, slab and beam construction, and description of their wire-tied cement sacks.

The Eclipse concrete mixer described at length in the March issue of MUNICIPAL ENGINEERING is fully illustrated and described in a thirty page booklet issued by the Standard Scale & Supply Co., 1345 Wabash Ave., Chicago, Ill.

A leaflet issued by the Stedman Johnson Manufacturing Co., 1007 Schofield Bldg., Cleveland, Ohio, describes the Stedman "Estimeter" which is used in scaling maps and measuring lines thereon.

The Allis-Chalmers Company, Milwaukee, Wis., have two very valuable booklets describing new types of machines which they are manufacturing. The first of these is devoted to centrifugal pumps and gives a full description of the general features of design, and points of value in their use. The second devoted to steam turbines and generators, is also exceptionally clear in the description of the machines in question; full illustration being given to show all points mentioned.

The May number of the publication of the Lehigh Portland Cement Co. is given entirely to the use of cement in chimney construction.

The lamp standard department of the Flour City Ornamental Iron Works, Minneapolis, Minn., is about to issue a new and handsome catalog which will contain a fully detailed account of the various "Corinthian," "Egyptian," "Capitol," and "Boulevard" designs, with half-tones on an actual scale of ½ inch to the foot. All that will be necessary is for the engineer or architect to take a ruler and apply same to the pictures, then he will have full details at his command. Specifications are included in the text.

The Geo. V. Cresson Co., Philadelphia, Pa., issue an interesting discussion of the comparative merits of jaw and gyratory crushers, with particular reference to their Buchanan all-steel rock and ore jaw crushers for mines, cement and stone-crushing plants.

The little "Monthly Pipe Parley" of the McWane Pipe Works, Lynchburg, Va., is a convenient memorandum book, which gives each month some valuable information about water and gas pipe, and it can probably be induced to make its monthly visits to any one interested by application to the company.

Trade Notes.

BRICK.

Louisville, Ky.—The contract for furnishing 200,000 vitrified blocks was let to the Peebles Paving Brick Co., Portsmouth, O.

CEMENT.

Golconda, Ill.—Special—A 3,000 barrel modern cement mill is to be constructed

by Omaha, Neb., capital. H. G. Calkins, City National Bank Building, Omaha, is interested in the plant.

Bedford, Ind.—Special—The property of the United States Cement Co. was sold at public auction to E. W. Shirk, representing the creditors of the company. The purchase price was $115,000.

Lynn, Mass.—The contract for furnishing 10,000 barrels of cement was let to Smith-Green Co., Boston, $16,500.

Kansas City, Mo.—Special—Due to the increase in business west of the Mississippi River, the McCormick Waterproof Portland Cement Co., of St. Louis, Mo., have opened another office in Kansas City, Mo., Reserve Bank Building, Room 332. Wm. H. K. Bennewitz has been appointed special representative of the company in that territory. The McCormick Waterproof Portland Cement Co., now has seven offices located in the following cities, viz: St. Louis, Mo., Chicago, Ill., New York City, Boston, Mass., Pittsburg, Pa., Toledo, Ohio, and Kansas City, Mo.

PURCHASE OF MACHINERY.

Palo Alto, Cal.—Special—A bond issue of $50,500 for the purpose of building an auxiliary pumping station, garbage destroyer, concrete water works building and purchasing an automobile fire engine, and steam condenser and water cooling tower, has been voted.

Washington, D. C.—Special—An American consular officer in Mexico desires names and addresses of American manufacturers of cast iron and iron pipe. Address the Bureau of Manufacturers, No. 6568.

Chicago, Ill.—Special—To handle more efficiently its increasing business in the middle west, the Iroquois Iron Works, of Buffalo, New York, have established a warehouse in Chicago, where a complete line of macadam and tandem rollers, asphalt tools, kettles, etc., is now carried for immediate shipment. The new shipping depot is in charge of T. H. Morris, the Chicago representative of the Iroquois Works, with offices in the Tribune Building.

Richmond, Ind.—The municipal electric plant is contemplating the installation of automatic stokers to cost about $6,000.

Duluth, Minn.—The board of public works is contemplating the purchase of an automobile truck.

Duluth, Minn.—The contract for laying Solvay calcium chloride in 8 sprinkling districts was let to the Board of Trade Livery Co., Duluth, Minn., at $18 per ten.

Rahway, N. J.—May 3, 8 p. m. Bids will be received for furnishing one 5,000,000 horizontal high duty cross compound crank and fly-wheel pumping engine, by Francis W. Langstroth, chairman committee on pumping.

Rochester, N. Y.—The contract for furnishing 2,300 tons cast iron pipe and special castings was let to the United States Cast Iron Pipe & Foundry Co., Rochester, N. Y., $53,270.

Galveston, Tex.—Bids will be received May 3, 12 m., for furnishing two centrifugal pumping units; piping, valves, etc., necessary to complete installation; each unit to consist of two single stage, 8-inch centrifugal pumps for direct connection to 107 kw. steam turbine, 3,600 rpm.; to be operated in parallel against a head of 55 pounds. Certified check $200. Address John D. Kelly, city secretary.

MISCELLANEOUS.

Chicago, Ill.—Special—R. Seelig & Son, manufacturers of engineering and surveying instruments, have removed to 231 North Fifth Ave., Chicago, Ill.

Moline, Ill.—L. O. Johns, commissioner of public property, Moline, Ill., desires catalogues of firms manufacturing equipment, materials and supplies used in municipal work.

Akron, Ohio.—Special—The Northern Ohio Traction and Light Co. have decided to develop their water power on the Cuyahoga river near this city. H. von Schon, consulting engineer of Detroit, Mich., is preparing plans and specifications.

Patents Concerning Cement Manufacture.

920,784. Cement Burning Apparatus. Henry S. Spackman, Ardmore, Pa.

926,561. Burner for Cement Kilns, etc. Wm. H. Harding, Philadelphia, Pa.

927,054. Tube Mill for Cement, Stone and the Like. Ira A. Knecht, Nazareth, Pa.

927,516. Tube Mill. Geo. S. Emerick, Nazareth, Pa.

928,512, 928,513. Processes of and Apparatus for Burning Cement and Like Materials. Byron E. Eldred, Bronxville, N. Y.

929,144, 929,145. Apparatus and Process for Making Cement. Robert W. Lesley, Haverford, and Henry S. Spackman, Ardmore, Pa.

929,167. Rotary Kiln for Burning Cement. Friedrich J. Poths, Hamburg, Germany.

930,697. Waterproof Cement and Method of Making the Same. Jacob F. Schoellkopf, Buffalo, N. Y.

930,946, 930,948, 930,949. Apparatus for Burning Portland Cement. Thos. A. Edison, Llewellyn Park, Orange, N. J.

932,374. Method of Making Portland Cement. Joseph M. Carrere, Allentown, Pa.

934,056. Process of Making Cement Clinker and Apparatus Therefor. Carleton Ellis, White Plains, N. Y.

935,617. Process for Manufacturing Cement. Maxmilian Trembour, Hartzburg, Germany.

936,555. Process and Apparatus for the Manufacture of Portland Cement. Chas. F. McKenna, New York, N. Y.

937,255. Drier. Richard K. Meade, Nazareth, Pa.

937,826. Ball Mill. Pool T. Lindhard, New York, N. Y.

938,176. Tube Mill Cement Feeder. Arthur E. Sparrow, Chicago, Ill.

939,044. Tube Mill, etc. Pool T. Lindhard, New York, N. Y.

939,049. Kiln. Chas. A. Matcham, Allentown, Pa.

939,078. Process of Making Cement and Other Products. Sam'l Peacock, Chicago, Ill.

939,817. Cement Kiln. Thos. A. Edison, Llewellyn Park, Orange, N. J.

941,630. Process and Apparatus for Artificially Aging or Seasoning Portland Cement. Thos. A. Edison, Llewellyn Park, Orange, N. J.

942,509. Cement Kiln. Thos. M. Morgan, Long Point, Quebec, Canada.

944,996, 944,997. Pebble Mills. Max F. Abbe, New York, N. Y.

945,307. Process and Apparatus for Burning Cement. Henry L. Doherty, New York, N. Y.

945,498. Multitubular Cement Kiln. Henry L. Doherty, Madison, Wis.

953,092. Combined Ball and Tube Mill. Joseph E. Kennedy, New York, N. Y.

953,258. Process of Making Hydraulic Cement. Joseph M. Carrere, Allentown, Pa.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

CONTEMPLATED WORK.

Tuscaloosa, Ala.—The city is contemplating building about 4,000 sq. yds. concrete sidewalk and 12,000 lin. ft. concrete curb and gutter. W. H. Nicol, cy. engr.

Clarksville, Ark.—W. A. Reams, of Ft. Smith, Ark., has been retained to make plans for road improvement.

Little Rock, Ark.—Wood block pavement to the amount of $45,000 is contemplated. E. A. Kingsley, cy. engr.

Washington, D. C.—An appropriation for $79,000 for paving will be available July 3rd. T. B. Hunt, engr. of highways.

Americus, Ga.—A bond issue of $105,000 has been passed for street improvements.

Newnan, Ga.—A bond issue of $150,000 has been passed for paving work.

Summerville, Ga.—A bond issue of $75,000 has been passed for the purpose of making street, sewer and water works improvements.

Harrisburg, Ill.—A $35,000 bond issue has been voted for hard surface roads.

Angola, Ind.—Plans are being prepared for paving of about 8 blocks of business district. Thomas Owens, mayor.

Huntington, Ind.—Construction of various stone and gravel roads is contemplated. John Weaver, audt. J. B. Vernon, engr.

Indianapolis, Ind.—The park commission has ordered the improvement of 39th st. known as Maple road by the construction of curbs and gutters and a macadam roadway. Henry Jameson, president board of park commissioners.

Michigan City, Ind.—The paving of Baltimore, Wabash and Willard streets is contemplated. M. R. Miles, cy. engr.

Peru, Ind.—The paving of Second street is contemplated. Michael Horan, cy. engr.

Valparaiso, Ind.—Pleasant township has voted $77,000 bonds for sixteen miles of gravel road.

Cedar Rapids, Ia.—City council has voted to construtc a wood block pavement on 16th ave., W., to cost $1,200.

Wichita, Kan.—The paving of Main st. to cost $79,000 is contemplated. City engineer Bert Wells.

Marblehead, Mass.—A bond issue of $50,000 for macadamized roads and sidewalks has been voted. John G. Stevens, selectman.

Carthage, Mo.—The city is contemplating the paving of Maple st., with asphalt macadam. F. B. Newton, cy. engr.

Kalispell, Mont.—City is contemplating the paving of the entire business area of the city with bitulithic. A. L. Jaqueth, cy. engr.

Boro of Queens, N. Y.—The paving of Church ave. with asphalt block on concrete fofundation, to cost $18,900, is contemplated.

Plattsburg, N. Y.—This city is contemplating $8,000 brick, asphalt or concrete paving. R. H. Rogers, cy. engr.

Whitesboro, N. Y.—A bond issue of $19,400 has been voted for the purpose of paving various streets.

Bellaire, O.—South Belmont street will be paved at a cost of $18,000.

Hammondsville, O.—The construction of eight miles of pike road is contemplated.

Marion, O.—Bids will be received soon of seven miles of macadam road. B. L. Alles, co. audt.

Toledo, O.—The paving of St. Clair st. with asphalt, bitulithic or wood block is contemplated. Estimated cost about $60,000. City engineer Tonson.

Ashland, Ore.—A $35,000 bond issue for street paving has been passed.

Forest Grove, Ore.—About 19 blocks will be paved with bitulithic.

Portland, Ore.—Skidmore hard surface paving district has been formed to lay bitulithic pavements to the amount of $321,770.

Newport, Pa.—Bids are being asked for repaving of Fifth ave., Sixth st. and further street improvements are contemplated.

Pittsburg, Pa.—Street improvement to the amount of $450,000 is contemplated. Director of public service, Joseph G. Armstrong.

Springdale, Pa.—A $10,000 bond issue for grading and paving streets and alleys has been passed.

Maryville, Tenn.—A $300,000 bond issue has been passed for the purpose of building pike roads.

Memphis, Tenn.—State road precinct No. 1 which includes Memphis, has voted $25,000 for road construction.

Aransas Pass. Tex.—Bonds to the amount of $100,000 for road improveemnt has been voted.

Crockett, Tex.—Bonds to the amount of $150,000 have been voted by Houston county for road construction.

Granger, Tex.—A $100,000 bond issue has been voted for the purpose of constructing roads.

Tacoma, Wash.—Cement sidewalks to cost about $12,000 are contemplated. W. C. Raleigh, cy. engr.

Madison, Wis.—Street paving to the amount of $278,126 is planned by the board of public works.

Winnipeg, Man., Can.—This city contemplates the spending of $5,000,000 on improvements to water mains, sewers, sidewalks and improvements.

CONTRACTS TO BE LET.

Bedford, Ind.—May 2, 1 p. m. Construction of two gravel roads. Ezra W. Edwards, audt.

Bloomfield, Ind.—May 2, 2 p. m. Construction of macadamized roads in Taylor township. P. H. Jennings, audt.

Bluffton, Ind.—May 4, 1 p. m. Construction of stone roads in Jackson township. C. D. Garrett, audt.

Brazil, Ind.—May 5, 11:30 a. m. Construction of gravel road in Van Buren. Griggs, Johnson and Posey townships. W. A. Staggs, audt.

Brookville, Ind.—May 9, 1 p. m. Construction of roads in Bath and Springfield townships. Chas. A. Miller audt.

Crown Point, Ind.—May 5. Construction of eight gravel roads. Charles A. Johnson, audt.

Decatur, Ind.—May 1, 10 a. m. Furnishing crushed stone and supplies for repair of roads. H. S. Michaud, audt.

English, Ind.—May 1, 2 p. m. Construction of pike road in Liberty township. J. Egan, audt.

Fowler, Ind.—May 1, 1 p. m. Construction of free stone road in Oak Grove township. Lemuel Shipman, audt.

Greencastle, Ind.—May 1. Constructing 13,000 feet macadam road in Madison township. D. B. Moffitt, audt.

Greenfield, Ind.—May 1, 10 a. m. Construction of retaining wall. Chas. H. Troy, audt.

Logansport, Ind.—May 2, 10 a. m. Construction of gravel road in Jefferson township. J. E. Wallace, audt.

Monticello, Ind.—June 7, 12 m. Construction of stone road on county line. A. G. Fisher, audt, Pike county.

Rockport, Ind.—May 2, 10 a. m. Construction two highways in Ohio township. John T. White, audt.

Rockville, Ind.—May 3, 1:30 p. m. Construction of gravel road in Pollard township. James G. Elder, audt.

Rushville, Ind.—May 1, 1 p. m. Construction of gravel roads in Rush, Shelby and Hancock counties. Jesse M. Stone, audt.

Salem, Ind.—May 1, 1:30 p. m. Construction of road in Gibson county. Frank S. Munket, audt.

Vernon, Ind.—May 1, 11 a. m. Construction of pike roads as noted in Bulletin of April 15. M. W. Brogan, audt.

Versailles, Ind.—May 1, 1 p. m. Constructing gravel roads. David H. Moffitt, audt.

Wabash, Ind.—May 2, 1 p. m. Construction of two gravel roads in Center township. J. P. Noftzger, audt. May 2, 1:30 p. m. Construction of two roads in Noble township.

Williamsport, Ind.—May 1, 1 p. m. Construction of gravel road in Clinton township. David H. Moffit, audt.

Iowa City, Ia.—May 5, 2 p. m. Constructing cement walks and crossings throughout the city. Certified check $25. George P. Redvick, cy. clk.

Newhampton, Ia.—May 3, 7:30 p. m. Constructing 12,000 sq. yds. of cement paving; and 1,600 ft. cement curbing. F. B. Strike, cy. clk.

Pittsburg, Kan.—May 3, 4 p. m. Constructing about 4,500 sq. yds. vitrified brick pavement, with asphalt filler. L. E. Burtman, cy. engr.

Boston, Mass.—May 2, 12 m. Paving Geneva ave. with brick paving. Certified check $5,000. Louis K. Rourke, com. of public works.

Charlevoix, Mich.—May 2. Paving 4,600 ft. on Michigan ave. with Tarvia, macadam, Sarco, bitulithic, asphalt, creosote block, brick, cement or concrete or other material. E. J. Hiller, cy. clk.

St. Louis, Mo.—May 5, 12 m. Bids will be received on the following paving work: Paving Clay ave. with asphalt, certified check $650; Ashland ave. with bituminous concrete, certified check $549; Greer ave. with sheet asphalt, certified check $653; Howard st. with bituminous concrete, certified check $975; 21st st. with bituminous concrete, certified check $1,133; Michigan ave. with vitrified brick, certified check $521; Linton ave. with vitrified brick, certified check $709; California ave. with vitrified brick, certified check $563; Idaho ave. with vitrified brick; certified check $479; Clara ave. with vitrified brick certified check $704; 15th st. with vitrified brick, certified check $630; Osceola st. with bitulithic, certified check $665; Wyoming st. with bitulithic, certified check $700; Spalding ave. with bitulithic, certified check $567; reconstructing 25th st. with bitulithic, certified check $1,136; reconstructing 7th st. and surfacing with yellow pine block, certified check $647; reconstructing Pine st. and surfacing with yellow pine block, certified check $735; reconstructing Benton st. and surfacing with yellow pine block, certified check $1,450. Maxime Raber, president board of local improvements. Wm. B. Finley, secy.

Hudson, N. Y.—May 2, 10:30 a. m. Paving Warren st. with vitrified brick. Commissioners of public works.

Lackawanna, N. Y.—May 15, 8 p. m. Paving Ridge road with vitrified brick. Certified check 10 per cent. Bond 50 per cent. John J. Monaghan, cy. clk.

Seneca Falls, N. Y.—May 4, 2 p. m. Paving State and Bayard sts. 25,000 sq. yds. brick or macadam. John M. Guin, cy. clk.

Barnesville, O.—May 15, 12 m. Paving North Lincoln ave. with brick. certified check $250. F. Waldo Hilles, clk.

Cincinnati, O.—May 2, 12 m. Paving Sumter ave. with brick, certified check $2,000; paving Whiteman ave. with wood block, certified check $700. John J. Wenner, clk, director of public service.

Cincinnati, O.—May 5, 12 m. Paving of Carthage ave. Certified check $1,000. Fred Dreihs, clk. Hamilton county.

Cleveland, O.—May 3, 11 a. m. Improving Hargitt road. Certified check $100. John F. Goldenbogen, clk. of Cuyahoga county.

Greenville, O.—May 6, 10 a. m. Constructing the following roads: Detrick, four sections, three of which are 2,640 and one 2,415 ft.; M. J. L. and Livingston roads in two sections, each about 2,640 ft.; Ross road in four sections, three of which are 2,640 and one 2,697 ft.; Baughman road in three sections, two of which are 2,640 and one 1,882 ft. Certified check $100 on each section. Frank Snyder, co. audt. Darke county ,O. Carl F. Frade, co. sur.

Minerva, O.—May 10, 12 m. Paving portions of Market, Valley, Wood and Lincoln sts. Certified check $500. Austin Freed, clk.

New Philadelphia, O.—May 22, 1 p. m. Paving 1,000 ft. of road in Warren township with brick. Certified check $100. W. C. Shott, audt. of Tuscarawas county.

Rockport, O.—May 12, 12 m. Constructing Settlement and Linndale roads. Certified check $200. Fred Feuchter, clk., Rockport, O.

Memphis, Tenn.—May 26. Constructing five miles gravel roadway, 3.9 miles tar macadam, 1.4 miles of vitrified brick, 2.9 miles wood block or bitulithic. George T. Lodge, st. com.

Ft. William, Ont., Can.—May 4, 5 p. m. Paving 14,000 sq. yds. with asphalt block sheet asphalt or bitulithic. John Wilson, cy. engr.

CONTRACTS AWARDED.

Covina, Cal.—Paving Piplus ave., to L. H. McGowan, Higgins blvd., Los Angeles, Cal., $37,693.

Long Beach, Cal.—Construction of 30 ft. cement blvd., to J. D. Kneen Concrete Co., Santa Monica, $110,985.

Los Angeles, Cal.—Street improvement awarded as follows: paving Selma ave., to A. W. Bessemyer, $18,627; Kenwood st., to Fairchild, Gilmore, Wilton Co.,

Pacific Electric Bldg., $9,429; Frees st., to L. N. Davies, $4,162; cement sidewalks, to Arthur Sikes, 959 W. 43rd st., $4,539; all firms in Los Angeles, Cal.

Redondo, Cal.—Contract for petrolithic paving to W. C. Henderson, 3030 N. Main st., Los Angeles, $26,100; petrolithic paving, to Venable & Morrell, of Redondo, $19,600.

San Francisco, Cal.—The following contracts have been let: Paving Cook st. to Reisph Improvement Co.; curbing S. Brazil ave. to Flinn & Tracy; paving 25th ave., 17th ave., and others to City Street Improvement Co.

Denver, Colo.—Paving in north side improvements district No. 14, to Municipal Construction Co., Denver, $15,723.

Canton, Ill.—Construction of pavements on South Park st., to Roller and Savill, Canton, Ill.

Chicago, Ill.—Paving work awarded as follows: Wood block, $2,316, to Central Paving Co., 172 Washington st.; wood block, $3,570, to McGarry, 188 Madison st.; $1,880, to Central Paving Co.; $1,951, to Alexander Todd, 197 N. Hamlin ave.; $2,555, asphalt work, to American Asphalt Paving Co., 138 Washington st.; $17,003, to Standard Paving Co., 1101 S. 48th st.; $7,436, to L. M. Conway Co., 138 Washington st.; $484, to Calumet Coal and Feed Co., 2926 95th st.; $101,107, to Parker-Washington Co., 138 Washington st.; $13,181, to Farr Bros., all firms in Chicago.

Murphysboro, Ill.—Contract for $21,000 paving, to Meyer-Thomas Co., of East St. Louis, Ill.

Bluffton, Ind.—Construction of twelve gravel roads, as follows: J. M. Fryback, gravel, $3,760; W. Clahoun, stone, $6,160; Turner & Sours, gravel, $6,060; J. M. Harris, gravel, $2,860; L. Sfl Walser, stone, $3,400; C. Stogdill, gravel, $4,160; S. Risley, macadam, $6,000; Isaac Jacobs, gravel, $3,400; Peter Wiesbrodt, macadam, $5,480.

Indianapolis, Ind.—The following contracts for cement walks have been let: Tremont st., to Henry Maag; Raymond st., to J. V. Baxter; Defrees st., to William H. Lackey; all of Indianapolis.

Kentland, Ind.—Constructing macadam road, to Alva D. Herriman, Brook, Ind., $5,982.

Knox, Ind.—Construction of two roadways, to James Sticker, Knox, Ind., $3,200.

Lafayette, Ind.—Construction of roads in Wabash township, $3,225, to B. H. Fatout, Indianapolis, Ind.; $6,000 road work, to Mahoney & Allen, Greencastle, Ind.

Logansport, Ind.—Construction of roads in Cass county to Fred Grover, Frank Justice and Beal & Beal, all of Logansport.

Monroe, Ind.—Construction of macadamized road in Wabash and St. Marys township, to Eli Entle & Sons, Monroe, Ind., $6,198 and $6,370.

Sullivan, Ind.—The following contracts have been let: 2 stone roads in Pike township, to D. E. Uzerhart, Sullivan, Ind.; and Keegan Bros., Brazil, Ind., $9,464 and $8,465 respectively; stone and oil road in Hamilton township, to Bageby & Cunningham, Linton, Ind., $3,430.

Ackley, Ia.—Constructing concrete and brick pavement, to John A. Beebe, Omaha, Neb.

Colfax, Ia.—Contract for paving to Turner Improvement Co., Des Moines, $50,000.

Des Moines, Ia.—Contract for street paving to Meyer Bros. Construction Co., of Erie, Pa., includes 18,000 yds. of asphalt.

Red Oak, Ia.—Construction of 30 blocks brick pavement to Hamilton & Schwartz, of Shenandoah, Ia.

Detroit, Mich.—The following paving contracts were awarded: Cedar block, $15,565 and $7,245, to Thomas G. Currie, 29 McGraw Bldg.; cedar block, two contracts, $24,642 and $11,841, to J. A. Mercier, 211 Hammond Bldg.; brick paving, $17,642, to Porath & Sons, 301 Penobscot Bldg.

Duluth, Minn.—Contract for cement walk to W. H. Kilpin, Duluth, $12,653; contract for cement walks to D. H. Clough, $14,297; cement walks on Park Point to D. H. Clough, $3,987; contract for laying solvay calcium chloride in 8 sprinkling districts to Board of Trade Livery Co., Duluth, Minn., at $18 per ton.

Meridian, Miss.—Constructing 20 miles paved highway to Healy Construction Co., McAlester, Okla.

Kansas City, Mo.—Construction of municipal wharf, to A. N. Blodgett Construction Co., Kansas City, $22,760.

Bloomfield, N. J.—Contracts for paving and road work were let as follows: Concrete work to Shire & Woods, Lyndhurst, N. J. and De Amato & Steffenalli, of 74 Sumner ave., Newark; Telford stone work, to Telford Construction Co., 22 Clinton street, Newark, and Fusco Construction Co., 671 Broad street, Newark N. J.

Albany, N. Y.—The following contracts have been let for road work: $55,847, to De Drass and Hozeboom, Kingston, N. Y.; $36,186, to same; $50,000, to Huckness Construction Ca., Albion, N. Y.; $49,670, to Breezen & Biton, 27 Williams st., New York City; $33,220, to Newport Construction Co., Newport; $80,550, to Joseph Walker, New Paltz, N. Y.; $49,950, to same; $7,800, to Fred W. Berger, Newport, N. Y.; $55,270, to Kennedy Roofing & Paving Co., Utica, N. Y.; $11,920, to John Hyde, Rome, N. Y.; $32,000, to Central City Paving Co., Syracuse, N. Y.; $65,458, to Thomas Meehan & Sons, Philadelphia, Pa.; $33,975, to Paddock & Williams, Memphis, N. Y.; $43,990, to Joseph H. Conners, Fulton, N. Y.; $66,999, to Folk & Menzies, Buffalo, N. Y.; $47,990, to Chas. O. McComb, Syracuse, N. Y.; $88,900, to James Stewart & Co., 30 Church st., New York City; $69,889, to John E. Johnson, Buffalo, N. Y.; $45,593, to Thomas Meehan & Sons, Philadelphia, Pa.; $69,800, to A. J. Rockwood, Rochester, N. Y.; $38,892, to Herrihy Contracting Co., Glens Falls, N. Y.; $60,000, to Catskill Construction Co., Catskill, N. Y.; $33,700, to Sphroezer-Hicks Contracting Co., Rochester, N. Y.; $2?,500, to Sontononi Construction Co., Newcomb, N. Y.; $63,300, to Thomas Grazy & Co., Rochester, N. Y.; $44,740, to John H. Weidman, Syracuse, N. Y.

New York, N. Y.—The following contracts were awarded; Granite block pavement, $28,875, to John E. Donovan, Port Richmond, N. Y.

Port Niagara, N. Y.—Constructing roads, walks, etc., to Lake Shore Construction & Supply Co., Dunkirk, N. Y., $12,988.

Rochester, N. Y.—Paving Genesee st., to Whitmore, Rauber & Vicinus, $25,041; brick pavement on Oak, to same, $42,912; asphalt pavement on Oak st., to Rochester Vulcanite Co., $20,610; asphalt pavement on Bloss st., to Rochester Vulcanite Co., $11,763.

Utica, N. Y.—Paving Wurz ave., to James W. Johnston, Utica, $17,770.

Fayetteville, N. C.—Constructing 10,000 feet paving, to Bowe & Page, Charleston, S. C.

Belle Valley, O.—Road construction, to

Juniper & Nixon, of Nelsonville, O., $10,332.

Findlay, O.—Construction of pike road in Huron county, to Taylor & Biggs, $42,000.

Lowellville, O.—Constructing sidewalks for a period of one year, to Kimbrough-Elder, Newcastle, O.

Lawton, Okla.—Paving 45 blocks, to C. H. Shaw, Lawton, Okla., $150,000.

Ingram, Pa.—Paving Stanley st., to Thomas Cronin Co., Pittsburg, $11,032.

Philadelphia, Pa.—Spring Garden st. resurfacing, to Barber Asphalt Paving Co., $15,000.

Knoxville, Tenn.—Constructing 10 miles of pike road, to Mann Construction Co., Knoxville.

Montesano, Wash.—Paving Spruce st., to Anderson Construction Co., Tacoma, $16,266.

Seattle, Wash.—Paving Sixth ave. with asphalt, to Barber Asphalt Co., Henry Bldg., Seattle, $30,990.

Tacoma, Wash.—Paving and laying cement sidewalks on various streets, to Keasal Construction Co., Providence Bldg., Tacoma, $23,894; asphalt paving, to Ollar-Robinson Co., 1322 South Yakima ave., Tacoma.

Racine, Wis.—Paving Eire and Dodd street, to McCugo-McCullock Co., of Waukegan, Ill., $14,626.

SEWERS.

CONTEMPLATED WORK.

Denver, Colo.—Sewers to cost $122,320 are to be constructed in sewer district No. 3. J. B. Hunter, cy. engr.

Summerville, Ga.—A $75,000 bond issue for street, sewer and water works improvements has been voted.

Waycross, Ga.—An extension to the sewer system to cost from $15,000 to $20,000 is contemplated.

Aurora, Ill.—Bids will be asked soon for about $105,000 of concrete and pipe sewers. M. J. Barble, cy. engr.

Anderson, Ind.—An 8 ft. sewer. 1¼ miles long, to cost $100,000, is contemplated.

Mount Vernon, Ind.—Bids will be asked soon for construction of storm sewer to cost $5,000. D. W. Farlls, cy. engr.

Newcastle, Ind.—City council will advertise for bids for building arch sewer over open stream. Estimated cost $50,000.

Clinton, Ia.—Receiving of bids for sewer district No. 4 has been postponed from April 4 to about May 2. I. P. Hart, cy. engr.

Bowling Green, Ky.—Plans are being prepared by state sanitary engineer, Paul Hansen, for the construction of a complete sewerage system for the city of Bowling Green.

Spencer, Mass.—A $1,000 sewage disposal plant will be constructed.

Austin, Minn.—City will construct 6,600 feet sanitary sewers. Martin Causen, cy. engr.

Ely, Minn.—A $30,000 bond issue has been voted for the purpose of a sewer system.

Madison, Mo.—A $200,000 sewer system is contemplated. B. H. Colby, St. Louis, engr.

Newark, N. J.—Sewers on Gardner and Dickerson sts. are contemplated. Alfred L. Swain, clk. bd. of street and water comrs.

Albany, N. Y.—Rudolph Hering, of New York City, has been retained to plan intercepting sewers.

Buffalo, N. Y.—Bids will soon be requested for the construction of sewers in various streets. Comr. pub. wks. F. G. Wood.

Boro of Queens, N. Y.—A sewer system in the Wave Crest section of Far Rockaway, estimated cost $24,850, is contemplated. The improvement will provide for 10-in. cast iron force main in Cedar ave. and an electric pumping station.

Mariana, O.—A $20,000 bond issue for the purchase of complete sewerage system from private company has been voted.

Marysville, O.—E. A. Kemmler, of Columbus, O., has been retained to furnish plans and specifications for a $100,000 sanitary sewerage system, which will be constructed immediately.

Toledo, O.—The sum of $3,000 has been appropriated to retain an engineer to make plans for removal of sewage in the Swan creek district. Sewer dir. Cowell.

Youngstown, O.—Sewers on State and Liberty sts. to cost $10,000 are contemplated. Cy. Engr. Wilson.

Britton, Okla.—A $20,000 bond issue for sewer improvements has been voted.

Eugene, Ore.—A $28,000 bond issue for sewer improvements has been voted.

Altoona, Pa.—Sewer extensions and a disposal plant to cost $260,000 are contemplated. Cy. Engr. Engstrom.

Beaver Falls, Pa.—Leo Hudson, of Haverstraw, N. Y., is preparing plans for a complete sewerage system and disposal plant for Beaver Falls.

Ligonier, Pa.—State board of health has ordered the village to build the sewage disposal plant.

Parker, Pa.—The city has been directed by state board of health to construct sewage disposal system and water filtration plant.

Springdale, Pa.—A $12,000 bond issue for a sewer system has been voted.

Clinton, S. C.—A $45,000 bond issue for sewer improvements has been voted.

Columbia, S. C.—The street department is authorized to advertise for bids on storm sewers on Dervais st.

Cuero, Tex.—A $30,000 sewer system, with disposal plant, is contemplated. Capt. S. R. Perkins, engr.

Milwaukee, Wis.—No bids were received on March 27 for the construction of a sewer on 25th ave. The work will be advertised again. John J. McGucken, dept. comr. pub. wks.

Winnipeg, Man., Can.—This city contemplates the spending of $5,000,000 on improvements to water mains, sewers, sidewalks and pavements.

CONTRACTS TO BE LET.

Pensacola, Fla.—May 2, 12 m. Constructing 15,060 lin. ft. of storm sewers, 10-in. to 60-in. in diameter; 23,880 lin. ft. sanitary sewer, 6 to 24-in. in diameter. Certified check, $2,000. John M. Merritt, chr. bd. of bond trus. George Rommel, Jr., engr.

Kokomo, Ind.—May 1, 12 m. Constructing sewers 10 to 48-in. in diameter, about 12,900 ft. in length. Certified check, $500. Bond, $25,000. John Havens, cy, clk.

Cloquet, Minn.—May 3. Constructing 1,300 lin. ft., 8 to 10-in. sewers. Cy. clk.

East Las Vegas, N. Mex.—May 17, 4 p. m. Constructing 23,000 ft. 8 to 15-in. vitrified pipe sewers. Certified check, $500. Chas. Tamme, clk.

Cleveland, O.—May 5, 12 m. Construction of sewers on Bessemer ave., southeast; East Eighty-eighth st.; Harris ave.; Marshall ave.; Pensacola ave.; east branch of Dugway brook intercepter, and part of Lorain ave. Separate bids re-

quired. A. B. Lea, comr. of pub. serv. Ira Hoffman, sec.

Elyria, O.—May 8, 12 m. Constructing sanitary sewers to cost about $27,000. Certified check, $1,000. Rose Moriarity, clk. D. S. Butts, engr.

Hubbard, O.—May 2, 12 m. Constructing sanitary sewers. Certified check, $1,500. J. Edward Schofield, vl. clk. Wm. Wilson, Youngstown, O., engr.

Xenia, O.—May 3, 11:30 a. m. Construction of sanitary sewer in Green county, Ohio, infirmary, and for the preparatory sewage treatment device. 10 per cent. certified check. Walter L. Dean, co. audt.

The Dalles, Ore.—May 15. Constructing sewer in District No. 1. L. T. Boyle, cy. engr.

Doylestown, Pa.—Construction of sewage disposal bed. Certified check, $200. Harrison & Sthreider, 2215-17 Land Title Bldg., Philadelphia, Pa., engrs. William Bishop, supt. of the Doylestown Sewage Co.

Williamsport, Pa.—May 24, 12 m. Construction of storm water sewer in Hepburn st. Certified check, 10 per cent. Robert J. White, chrmn. of com. on highway and sewer imp. J. J. Galbraith, cy. clk.

Reedsburg, Wis.—May 17, 5 p. m. Constructing trunk sewer on Franklin st., including 1,650 ft. of 30-in. pipe, 1,200 ft. 27-in. pipe, 1,410 ft. 16-in. pipe, 10 manholes, 22 catchbasins, etc. Certified check, 5 per cent. A. H. Hueding, cy. clk.

Ft. D. A. Russell, Wyo.—May 8, 9:30 a. m. Constructing 2,125 lin. ft. 8-in. vitrified pipe sewers; 2,900 lin. ft. 6-in. vitrified pipe; 9 manholes. F. S. Armstrong, const. q. m.

Toronto, Ont., Can.—May 9, 12 m. Constructing sewers as noted in Bulletin of April 15. D. R. Geary, mayor.

CONTRACTS AWARDED.

Mobile, Ala.—Constructing storm sewers in the Eighth paving district, to Sullivan & Lang, Bessemer, Ala., for $26,019.

San Francisco, Cal.—The following contracts have been let: Grade and sewer on 25th ave., to Frank L. Sheerin; sewer on 32d ave., to E. E. Gallagher.

Winters, Cal.—Plans for a sewer system to cost $28,000 have been adopted by the city council. Haviland & Tibbets, engrs., Oakland, Cal.

Colorado Springs, Colo.—Constructing sewers, to Westcott-Doan Investment Co., Gas and Electric Bldg., Denver, Colo., for $4,208.

Ft. Morgan, Colo.—Constructing sewers to Meeker & Gobson, of McCook, Neb., for $5,146.

Stamford, Conn.—Sewer construction, to Frank Palmer, Stamford, for $45,543.

Moline, Ill.—Construction of sewer system to E. R. Harding & Co., Racine, Wis., $50,995.

Peoria, Ill.—Resurfacing Perry ave. with asphalt, to J. W. Bushell, Peoria, Ill., for $25,713.

Tampico, Ill.—Constructing open ditch, to A. O'Mara, Cullom, Ill., 85,000 cu. yds. excavation.

Indianapolis, Ind. — Construction of brick sewer, to American Construction Co., 1201 E. Georgia st., Indianapolis, Ind., for $72,152.58.

Kokomo, Ind.—Contract for construction of Tudor drain, to Indiana Drain Tile Co., of Brooklyn, Ind., for $27,393.

Michigan City, Ind.—Contract for construction of 12 miles of Porter ditch, to Yoder & Swartz, Nappanee, Ind., for $10,000.

Indianola, Ia.—Sewer construction, to Lydle Construction Co., Sioux City.

Nappanee, Ind.—Contract for drainage work to Nappanee Drainage Co., of Nappanee, Ind., $63,000.

Easton, Md.—Construction of sewer system, to Hines & Hayman, Baltimore, Md., for $37,001.

Albert Lea, Minn.—Constructing lateral sewers, to J. J. Connolly, St. Paul, Minn., for $3,143.

St. Cloud, Minn.—Sewer construction in East Side, to Ilstrup & Olsen, Minneapolis, Minn., for $8,826; West Side to Carl Krapp, St. Cloud, Minn., for $20,103.

South Orange Township, N. J.—Construction of sewers in Milton district, consisting of 8 to 12-in. vitrified pipe sewers, manholes, flush tanks, all appurtenances, to J. J. Fusco, of Montclair, N. J., for $18,246. Alexander Potter, 146 Liberty st., New York City, con. engr.

Watertown, N. Y.—Constructing a 20-in. sewer in 2d ward, to Burns Bros. & Healy, Watertown, N. Y., for $17,343.

Cincinnati, O.—Construction of sewers to the amount of $3,500, to James McLane & Sons, Cincinnati, O.

Dayton, O.—The contracts for sewer work were awarded to the following contractors, all of Dayton: Hucker & Kirschner, John F. Cooke, Shafor & Dill, A. J. Kanner.

Girard, O.—Constructing sewers, to Dan Mercer Construction Co.

Millersburg, O.—Contract for sewer in northern part of the city, to Lee & Griggs, Millersburg, O.

New Salem, O.—Constructing sewers on South Union, Evans, Garfield and other streets, to John Devine, Alliance.

Russell, O.—Constructing various sewers, to Scherer & Mountain, Ironton, O., for $10,891.

Salem, O.—Construction of sewers on South Union and Evans sts., Garfield ave., Wilton, Newgarden, Liberty and Fair sts., to John Devine, of Alliance, for about $9,000.

Zanesville, O.—The contract for sewer in Marble alley, to John Tooper, Zanesville, O.

Newburg, Ore. — Constructing sewer system, to T. S. Sheppard, Portland, Ore., for $75,940.

Silverton, Ore.—Constructing water and sewer systems, to Mars Construction Co., Seattle, Wash., for $63,940.

Carnegie, Pa.—Contract for sewer on Orchard ave., to William Donnelly, Carnegie, Pa.

Glassport, Pa.—Constructing about 3,915 ft. of 6 to 18-in. terra cotta pipe sewers, to McLaughlin Construction Co., Pittsburg, Pa.

Grove City, Pa.—Sewer construction, to Thomas & Saull, Grove City, approximately, $2,000; Dunn Leader Construction Co., Steubenville, O., approximately, $13,000.

Williamsport, Pa.—Construction of East End sewer, to George W. Rockwell, Sunbury, Pa., for $20,631.

Columbia, S. C.—Construction of sewers on Gervais st., to R. E. and E. N. Beaty, Georgetown, S. C., for $10,192.

Cameron, Tex.—Constructing sewer system, to Hamilton Bros. Construction Co., Chicago, Ill.

Galveston, Tex.—Dredging of Galveston's channel, to L. B. Gaylord, Houston, for $281,400.

Honey Grove, Tex.—The Honey Grove Sewer Co. has been incorporated, with a capital stock of $10,000, by J. W. Hadley and S. M. Kemp.

Seattle, Wash.—Sewer construction to Hayden & Sons, Seattle, Wash., for $18,889.

Milwaukee, Wis.—Contract for sewer construction in South district, to George Zimmerman, for $15,000; contract for sewer work in same district to T. J. Fzukalfki.

Racine, Wis.—Constructing sewer in Spring st., to P. C. Johnson, Racine, Wis.

Stoughton, Wis.—Constructing sewers, to E. R. Harding, Racine, Wis., for $20,411.

WATER WORKS.

CONTEMPLATED WORK.

Mena, Ark.—$60,000 waterworks plant will be constructed. John Thompson, chr. bd. of imps.

Palo Alto, Cal.—A bond issue of $50,500 for the purpose of building an auxiliary pumping station, garbage destroyer, concrete waterworks building, an automobile fire engine, and steam condenser and water cooling tower, has been voted.

Sisson, Cal.—Voted $40,000 bonds for improving waterworks system.

Gunnison, Colo.—A $90,000 bond issue for waterworks has been voted. Burns & McDonnell, Kansas City, Mo., engrs.

Flowery Branch, Ga.—This village is contemplating the installation of a $6,000 waterworks system. P. R. Parson, mayor.

Summerville, Ga.—A bond issue of $75,000 has been passed for the purpose of making street, sewer and waterworks improvements.

Mountain Home, Ida.—A $35,000 bond issue has been voted for the purpose of constructing a city water system. P. M. Blake, Boise, Ida., engr.

Troy, Ida.—Voted $12,000 bonds for the construction of a waterworks system.

Bloomington, Ill.—The extension of water mains on Mason st. is contemplated.

Rockdale, Ill.—The village has decided to erect a municipal water plant and build a distributing system to cost $25,000.

Rushville, Ill.—The Fuller-Coult Co., Chemical Bldg., St. Louis, Mo., has been retained to prepare plans for complete pumping station and waterworks system, to cost $30,000.

Shelbyville, Ill.—Shelbyville Water Co. will construct a 2,000,000-gal. reservoir Charles Chester, supt.

Des Moines, Ia.—The city is contemplating the purchase of a municipal water plant owned by private corporation.

Burton, Kan.—A $15,000 waterworks system is contemplated. Rollings & Westover, Beals Bldg., Kansas City, Mo., engrs.

Emporia, Kan.—In connection with changing pumping system from steam to electricity, city will purchase 3½ miles transmission line, two 3,000,000-gal. pumps and booster pump. Bids asked early in May. Fred H. Smith, cy. clk. Matthew Brown, cy. engr.

Kansas City, Kan.—A bond issue of $350,000 for the constructing of a municipal lighting system has been voted.

Sedgwick, Kan.—A waterworks system to cost $20,000 is contemplated. R. R. Hobbe, cy. clk.

Dawson Springs, Ky.—Plans will soon be prepared for the construction of waterworks system to cost about $15,000. J. W. Holmes.

Dexter, Minn.—Voted bonds for the construction of a waterworks system.

Mankato, Minn.—A $20,000 bond issue has been voted for the purpose of constructing waterworks system.

Power, Minn.—A $16,000 bond issue for construction of waterworks plant has been voted.

Waseca, Minn.—A waterworks system to cost $15,000 is contemplated.

Bassfield, Miss.—Bonds have been voted for the purpose of installing a waterworks plant.

Princeton, Mo.—This city is contemplating the construction of a waterworks system. Rollins & Westover, engrs., Beals Bldg., Kansas City, Mo.

Shelby, Mont.—Contemplating the construction of a waterworks system to cost about $35,000.

Bridgeport, Neb.—A $17,500 bond issue for waterworks has been voted.

Newark, N. Y.—This city has voted $8,000 for the extension of waterworks mains and installation of additional equipment.

Newport, N. Y.—This city has issued $15,000 bonds for improvement of waterworks system.

Tarrytown, N. Y.—Voted $70,000 bonds to enlarge water supply.

Kenton, O.—A $40,000 bond issue for waterworks plant has been voted.

Urbana, O.—The city is contemplating the erection of a municipal water plant.

Boswell, Okla.—A bond issue of $27,000 for new waterworks system has been passed.

Helena, Okla.—A $10,000 bond issue for waterworks has been voted. L. A. Ruley, cy. clk.

Oklahoma City, Okla.—Bids will be requested soon for waterworks improvement, including $12,000 sedimentation basin, new boilers, 200,000-gal. equalizing tower, and about 28 miles of mains.

Madras, Ore.—A bond issue of $10,000 has been voted for a complete city water system, including 13,000 feet of mains.

Oil City, Pa.—Waterworks improvements to cost $18,000 are contemplated.

Pittsburg, Pa.—The construction of a reservoir on Cabbage Hill is contemplated. Director of pub. wks., Joseph G. Armstrong.

South Sharon, Pa.—A $160,000 waterworks system is contemplated.

Springdale, Pa.—A $50,000 bond issue for building a municipal water plant has been passed.

Alvin, Tex.—Franchise for waterworks system in this city was granted to a company of which T. P. Magaois and W. P. Hunt, of Alvin, Tex., are interested.

Lott, Tex.—Bonds to the amount of $14,000 have been voted for construction of waterworks.

Victoria, Tex.—Extensions to the waterworks system are planned.

White Salmon, Wash.—Contemplating the construction of waterworks. C. H. Estes, town clk.

Milton, W. Va.—The Milton Water Co. has been incorporated to build a waterworks system for city.

Wheeling, W. Va.—A bond issue of $300,000 for the erection of filtration plant has been ordered.

Antigo, Wis.—Waterworks improvements to the amount of $10,000 are contemplated. Improvement includes 425,000-gal. reservoir.

CONTRACTS TO BE LET.

Cloquet, Minn.—May 1. Constructing 12,000 lin. ft. 6 and 4-in. water main. Cy. clk.

Buffalo, N. Y.—May 4, 11 a. m. Construction of two brick tunnels on east side of Front ave. pumping station. Certified check, 50 per cent. Francis G. Ward, comr., 5 Municipal Bldg.

Lakewood, O.—May 9, 12 m. Constructing steel water tower as noted in Bulletin of April 15. E. R. Lieblion, clk.

CONTRACTS AWARDED.

Kingsbury, Cal.—Constructing a municipal waterworks, to Braun, Williams & Russell, of Redondo Beach, Cal., for $25,000.

Terra Bella, Cal.—Constructing waterworks and sewer system, to Western Engineering and Water Supply Co., Oakland, Cal., for $6,034.

Sparta, Ga.—Construction of complete waterworks system, to Walton & Wagner, Atlanta, Ga., for $34,000.

Canton, Ill.—Contract for waterworks extension and deep well improvement, to Cook Construction Co., Des Moines, Ia., for $6,801.

East Mobile, Ill.—Constructing waterworks system complete, to E. R. Harding, Racine, Wis., for $13,500.

Coldwater, Kan.—Construction waterworks and electric light systems, to Fred M. Clark, Havana, Mo., $29,180.

Hornell, N. Y.—Construction of closed reservoir, to Fahy & Prentice, of Hornell, for $37,000. Laying 15 miles of pipe, to Gray & Miller, of Hornell, for $10,000.

Ogdensburg, N. Y.—Construction pumping station, filter intake and mains, to L. B. Cleveland, Watertown, N. Y., for $29,849.

Lakeside, O.—Contract for a filtration plant, to Pettibone & Dankleson, Lakeside, O.

Lexington, O.—Contract for complete waterworks system to National Co., South Bend, Ind., for $62,165.

Checotah, Okla.—Installing waterworks station, laying pipe, etc., to C. R. Nichols, of Checotah, Okla., $13,160.

Indiana, Pa.—Constructing filtration plant for refuse of Indian Brewery, to P. J. McGovern, Indiana.

Columbia, S. C.—Constructing water mains, to Weston & Brooker, $2,268; pipe and supplies, to Lynchburg Foundry Co., Lynchburg, Va., for $3,780.

Gettysburg, S. D.—Construction of complete water system, to Cook Construction Co., of Des Moines, Ia., for $14,000. F. M. Wright, cy, audt.

Dawson, Tex.—Contract for $15,000 water system to J. S. Williams, Dawson.

Galveston, Tex.—Construction of duplicate mains across Galveston Causeway, to Isaac Heffron, Galveston, for $66,389.

Prescott, Wis. — Construction waterworks system to Des Moines Bridge and Iron Co., Des Moines, Ia., $19,419.

BRIDGES.

CONTEMPLATED WORK.

San Bernardino, Cal.—Contemplating the construction of a wooden bridge to span Mojave river near Victorville, to cost $12,000.

Santa Barbara, Cal.—Plans will be prepared for a concrete bridge to span the Santa Ynez river, to cost $40,000. Frank F. Flournay, co, sur.

Thomasville, Ga.—The commissioners of Thomas county have decided to replace all wooden bridges by steel bridges.

Plymouth, Ind.—The construction of two 60-foot concrete bridges is contemplated. County commissioners of Marshall and Fulton counties.

Wichita, Kan.—The construction of a $20,000 steel bridge on 13th st. is contemplated. Co. comrs.

Barbourville, Ky.—Six steel bridges will be constructed in Knox county.

Foxcroft, Me.—Bonds to the amount of $25,000 have been appropriated for construction of concrete bridge.

Kalamazoo, Mich. — Construction of bridge on Alcott st. is contemplated.

Oklahoma City, Okla.—A charter was granted to the Lexington Auto Bridge Co., of Lexington, Ky., with $25,000 capital, the purpose of the company being to build a bridge between Lexington and Purcell. The directors are J. A. Brownell, L. J. Brownell and A. Brownell, all of Lexington.

Shawnee, Okla.—Contemplating the construction of three bridges. Bd. co. comrs.

Gettysburg, Pa.—The construction of a 98-foot reinforced concrete bridge over Possum creek at Aspers is contemplated.

Pittsburg, Pa.—County will build 16 bridges, to cost $281,250.

Angleton, Tex.—Bonds to the amount of $100,000 have been voted for the purpose of building two bridges across the Brazos river.

Dallas, Tex.—Contemplating the construction of three modern drawbridges, to cost about $75,000.

Lampasas, Tex.—Bonds have been voted for the erection of a bridge to cross the Lampasas river.

Smithville, Tex.—A concrete bridge over Gosly creek is contemplated.

Wichita Falls, Tex.—Bonds to the amount of $151,000 have been voted to build bridges across the Wichita river.

CONTRACTS TO BE LET.

Bloomfield, Ind.—May 3, 2 p. m. Construction of three bridges of 70, 60 and 40-ft. spans, respectively. Caswell H. Jennings, audt.

Bluffton, Ind.—May 4. Construction and repair of fifteen bridges. O. D. Redd, audt.

Brazil, Ind.—May 2, 10 a. m. Constructing four concrete steel culverts. D. B. Huntington, audt.

Decatur, Ind.—May 2, 10 a. m. Constructing a number of bridges and arches. H. S. Michaud, audt.

Lebanon, Ind.—May 2, 1 p. m. Construction and repair of thirty-two bridges. B. S. Herdrich, audt.

Newport, Ind.—May 15, 1 p. m. Repairing Perryville bridge. H. E. Payne, audt.

Plymouth, Ind.—May 2. Construction of two bridges on county line road. Chas. M. Walker, audt., Plymouth.

Princeton, Ind.—May 3, 11 a. m. Construction of twelve steel bridges. W. D. Roberts, audt.

Rockville, Ind.—May 3, 1:30 p. m. Repairs to several bridges. James G. Elder, audt.

Shelbyville, Ind.—May 2, 10 a. m. Construction four concrete-steel culverts. G. B. Huntington, audt.

Shelbyville, Ind.—May 8. Construction of concrete abutments and repair work on St. Paul bridge. G. B. Huntington, audt.

Washington, Ind.—May 3, 2 p. m. Construction of seven bridges. Thomas Nugent, audt.

Columbus, O.—May 16, 12 m. Building substructure and approaches to Wilson bridge. Certified check, $500. F. M. Sayre, county auditor, Franklin County.

Hamilton, O.—May 9, 10 a. m. Constructing small culvert and bridges in Madison township. Certified check, 10 per cent. J. E. Brate, co. audt.

CONTRACTS AWARDED.

De Witt, Ark.—Contract for construction of steel bridge, to Memphis Bridge Co., Memphis, Tenn., for $2,500.

Fillmore, Cal.—Piru bridge awarded to the Missouri Valley Bridge and Iron Co., Denver, Colo., for $19,210; Sheicoy bridge

awarded to Merry-Elwell Co., Oakland, Cal., for $53,800.

Los Angeles, Cal.—The contract for Arroyo steel bridge, to Memphis Bridge Co., Memphis, Tenn., for $2,500.

Champaign, Ill.—Constructing a bridge 75 ft. long and 20 ft. wide, to J. M. Breese, Mattoon, Ill., for $14,000.

Lake Bluff, Ill.—Construction of $10,000 bridge, to James Corse, Racine, Wis.

Tremont, Ill.—Constructing two reinforced concrete bridges in Elm Grove township, to Porter-McCulla Contracting Co., Mackinaw, Ill.

Clay City, Ind.—Construction of a bridge, to L. W. Gibens & Sons, Saline City, Ind.

Greenfield, Ind. — Constructing three bridges to Greenfield Bridge and Sewer Co., Greenfield, Ind.

Huntington, Ind.—Constructing ten arch bridges, to I. J. Walker, Pennville, Ind.

Newcastle, Ind.—Construction of steel and concrete bridges in Adams county, to E. J. & H. S. Burke, at Newcastle, Ind., $4,448.

Rockport, Ind.—Contract for 25 bridges in Spencer county awarded to following contractors: Vincennes Bridge Co., Vincennes, Ind.; A. L. Greenburg Co., Greensburg, Ind.; Haines & Kinman, Evansville, Ind.

Cedar Rapids, Ia.—Constructing a 6 span concrete bridge on 3d ave., over Cedar river, and reconstructing the present 3d ave. bridge on 8th ave., to B. J. Sweatt, Boone, Ia.

Louisville, Ky.—Construction of steel viaduct, to Grainger & Co., of Louisville, for $800,000; concrete work, to B. D. Milner & Sons, Louisville, Ky.

Kansas City, Mo.—Construction of Fifth st. bridge, to Western Bridge Co., Harrisonville, Mo., for $9,400.

Bronxville, N. Y.—Construction of 2-arch bridge, to O'Rourke Construction Co., Yonkers, N. Y., for $9,227; construction of bridge, to E. J. Boyle & Co., N. Y., $7,742.

Falconer, N. Y.—Contract for 2 bridges on S. Wood st., to F. P. Benson & Co., of Falconer, $7,886; contract for E. Main st. bridge, to G. P. Holcomb, of Kennedy, $6,500.

Petersburg, N. Y.—Constructing 85-ft. span reinforced concrete arch bridge across Little Hoosick river, to Cole-Mortland Co., White Creek, N. Y., for $2,700.

Canton, O. — Construction of small bridges, to Peter Hahn & Son, of Canton.

Findlay, O. — Contract for county bridges, to Ebbington & Burnett, Findlay.

Hamilton, O.—Construction of small bridges, to the following-named contractors: P. F. Brace, J. P. Guillaume, B. E. Snider, all of Hamilton.

Youngstown, O.—Construction of bridge over reservoir, to Hunter Construction Co., Youngstown, O.

Pittsburg, Pa.—Contract for Larimer ave. bridge to Booth & Flynn, for $139,-922.

Reading, Pa.—Mohnton bridge No. 1, to Carl R. Camp, Montrose, $5,461; Borgners bridge No. 1, to Willauer & Co., of Pottstown, Pa., for $7,399; Borgners bridge No. 2, to Nelson, Meredyth & Co., of Chambersburg, Pa., for $6,560.

Reading, Pa.—Repairing various bridges, to Harry A. Gernert and James M. Smith, and L. H. Fothe & Sons, of Reading, Pa.

Yardley, Pa.—Construction of concrete bridge across Delaware river, to S. M. Talbot Co., New York City.

Yankton, S. D.—Constructing a steel bridge over Rhine creek at Walnut st., to Ellerman & McLain, Yankton, S. D., for $4,295.

Bristol, Tenn.—Construction of steel bridge over Sinking creek, to Morris Gopo, of Chattanooga, Tenn.

Memphis, Tenn.—Constructing a steel bridge to Memphis Bridge Co., Memphis, Tenn., for $2,500.

Fredericksburg, Va.—Constructing a steel bridge 35 ft. long, with 12-ft. roadway, superstructure to be of concrete, to Roanoke Bridge Co., Roanoke, Va.

Richmond, Va.—Construction of new bridge, to I. J. Smith & Co., Richmond, Va., for $232,061.

Roanoke, Va.—Constructing a steel bridge, 35 ft. long, with 12-ft. roadway, to E. C. Woodward, Richmond, Va.

Seattle, Wash.—Constructing a steel bridge over 5th ave. at Yesler Way, to American Bridge Co., Seattle, Wash.

Superior, Wis.—Constructing a bridge over Nemody river, to Hennepin Bridge Co., Minneapolis, Minn., for $4,940.

STREET LIGHTING.

CONTEMPLATED WORK.

Decatur, Ala.—Contemplating the construction of an electric light plant. Cy. coun.

Gurdon, Ark.—City has granted a 30-year franchise to J. G. & J. E. Graham to erect an electric light and water plant.

Newport Beach, Cal.—Contemplating the construction of an electric light plant. L. S. Wilkinson, cy. clk.

Atlanta, Ga.—The installation of ornamental lights on Pryor st. is contemplated.

Colquitt, Ga.—A $22,000 bond issue for erection of electric light plant has been voted.

Fairburn, Ga.—A $10,000 bond issue for the construction of electric light plant has been voted.

Pelham, Ga.—This city has voted $25,-000 bonds for the extension of the water and light plants.

Garrett, Ind.—Contemplating enlarging the municipal electric light plant. Cy. coun.

Kendallville, Ind.—This city is contemplating the installation of a boulevard, with lighting system. George Hess, chr. light com.

Shoals, Ind.—Construction of electric light and power plant is contemplated. S. W. Bateman, cy. engr.

Quincy, Ill.—The installation of 64 ornamental lighting standards is contemplated. Robert Halbath, chr. of commerce com.

Redfield, Ia.—Contemplating the construction of an electric light plant.

Red Oak, Ia.—The city is contemplating the installation of ornamental street lights.

Escanaba, Mich.—A $40,000 bond issue for construction of a municipal light plant has been voted.

Duluth, Minn.—The city engineer has been instructed to prepare estimate of cost of electric light and power plant.

Newton, Miss.—Voted $11,000 bonds for the construction of an electric light plant. W. A. Gilmore, cy. clk.

Hastings, Neb.—A $120,000 bond issue for municipal lighting plant has been voted.

Rochester, N. Y.—The Rochester Railway and Light Co. has been directed to lay underground conduits on a number of streets.

Barberton, O.—Bids will be requested soon for lighting streets for term of years. Present contract expires on June 1st.

Sandusky, O.—The director of public service has been directed to advertise for bids for lighting the streets for a period beginning January 1, 1912, and ending December 31, 1913. Joseph Loth, Jr., clk. coun.

Zanesville, O.—This city is contemplating the erection of thirty electric lighting arches.

Helena, Okla.—A $10,000 bond issue for electric lighting plant has been voted. L. A. Ruley, town clk.

Eugene, Ore.—A $25,000 bond issue for installing pumping and lighting system has been voted.

Lock Haven, Pa.—The city is contemplating the installation of about 49 five lamp ornamental lighting standards. Henry Hipple, chairman, board of trade committee.

Newcastle, Pa.—City is considering the construction of $100,000 municipal electric light plant.

Bayfield, Wis.—Extensive improvements on the light plant are contemplated.

CONTRACTS TO BE LET.

Benicia, Cal.—May 3. Furnishing electric supplies for one year from June 30, 1911. Lieut-Col. J. W. Benett.

Winnipeg, Man., Can.—May 1, 11 a. m. Furnishing ornamental lighting standards. Magnus Robertson, secy. board of public works.

CONTRACTS AWARDED.

Escondido, Cal.—Contract for lighting city streets with 60 arc lamp for a period of five years, to Escondido Utilities Co.

Jacksonville, Fla.—The following contracts have been let for machinery in electric light power station; boilers to Babcock & Wilcox Co., New York, $39,384; two 1600 kw. turbo generators and two 100 kw. turbo exciters, to General Electric Co., of Schenectady, $54,650.

Key West, Fla.—Furnishing and maintaining tungsten lights for a term of three years, to Key West Electric Co.

Chicago, Ill.—High power generator and high tension transformer to Crocker-Wheeler Co., $24,900, and the W. A. Jackson Co., $17,492, respectively.

Columbia City, Ind.—Installing complete electric system, to Ft. Wayne Electric Co., Ft. Wayne, Ind.

Shreveport, Ill.—Lighting system for a term of five years to Shreveport Railway & Light Co., arc light, $67 per year; boulevard lights, $36 per pole.

Richmond, Ind.—Engines and generator equipment for municipal electric light plant, Hooven, Owens, Rentschler Co., Hamilton, O., $8,260.

Adair, Ia.—Constructing a combined electric light and water works plant, to Des Moines Bridge and Iron Co., Des Moines, Ia., $28,460.

W. Sioux City, Ia.—Contract for a municipal electric light and power plant, to C. E. Hekinson, Sioux City, $9,900.

Webster City, Ia.—Erecting new city electric light and power plant, to C. E. Atkinson, Webster City, Ia., $9,897.

Carlisle, Ky.—The Carlisle Electric Light and Power Co., has been given contract for lighting streets for a term of years.

Frankfort, Ky.—The city has contracted with the Capitol Gas and Electric Light Co. for street lighting for a term of twelve years.

Salem, Mass.—Lighting streets for a term of years to Salem Lighting Co.

Eveleth, Minn.—Furnishing and installing ornamental street lights, to John S. Swanson, Duluth, Minn., $4,796.

Auburn, N. Y.—Furnishing and maintaining 35 ornamental lamps for a period of ten years, to Auburn Light, Heat & Power Co.

Auburn, N. Y.—Construction of fibre conduit on E. Genesee street, to Brayer Bros., Auburn, N. Y., $26,285.

Cincinnati, O.—Contract for street lighting for a period of ten years, to Union Gas and Electric Co.

Franklin, Pa.—Contract for lighting city streets for a term of 9 years to Franklin Electric Co.

Seattle, Wash.—Constructing cluster lights on 3rd ave., etc., to R. E. Downie, Seattle, Wash.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

CONTEMPLATED WORK.

Palo Alto, Cal.—A bond issue of $50,500 for the purpose of building auxiliary pumping station, garbage destroyer, concrete water works building, an automobile fire engine, and steam condensor and water cooling tower, has been voted.

Wilmington, Del.—A new crematory will be built to replace the one that was burned recently. Wilmington Sanitary Co. E. H. Woodward, secy.

Rochester, N. Y.—Construction of an incinerator to Decarie Incinerator Co., Minneapolis, $82,950.

Lorain, O.—The director of public service has been authorized to advertise for bids for collecting and disposing of city garbage.

Salem, O.—L. E. Chapin, of Canton, O., has been retained to prepare plans for new garbage disposal plant to cost about $50,000.

McKees Rocks, Pa.—A special committee has been named by the council to inspect garbage disposal plants and report to the council.

CONTRACTS TO BE LET.

Washington, D. C.—Furnishing 30 one horse two wheel carts for street cleaning department. Property clerk, 320 District Bldg.

Batavia, N. Y.—May 16, 10 a. m. Constructing Imhoff settling tank, sprinkling filters, and pludge drying beds. Certified check 5 per cent. Hering & Fuller, 170 Broadway, New York, engrs. John H. Wood, clk. bd. of sewer com.

Buffalo, N. Y.—May 6, 11 a. m. Building foundations for 40-ton Heenen-Froude, 3-grade destructor; boiler, hot air duct, flue and blower; removing present Morse-Boulger destructor; placing 125 h. p. Geary water tube boiler and building setting. Certified check 50 per cent. Sanford G. Ward, com., 5 Municipal Bldg.

Toledo, O.—May 3, 12 m. Furnishing two flushing wagons for street cleaning purposes. Certified check, $100. Fred Shane, secy., director of public service.

Erie, Pa.—May 8, 8 p. m. Construction of an incinerator plant. Certified check 10 per cent. B. E. Briggs, cy. engr. Chas. C. Brown, consult. engr. Indianapolis, Ind.

CONTRACTS AWARDED.

Troy, N. Y.—Disposal of city garbage for two years, to Zeph. F. Magill, Troy, N. Y., $1,000 per month.

Tiffin, O.—Collecting city garbage for one year, to Albert Shultz, Tiffin, O., $1,090.

Carnegie, Pa.—Garbage collection to W. H. Proffer, for 3 years, $4,200.

Lancaster, Pa.—Contract for the garbage disposal for one year with the privilege of 4, to the Conestoga Garbage Co., Lancaster, Pa., $8,888.

FIRE APPARATUS.

CONTEMPLATED WORK.

Lodi, Cal.—City is contemplating the purchase of automobile wagon and other equipment.

Los Angeles, Cal.—Council has been asked to appropriate money for 6 new ladder trucks, 6 auto pumping engines and 6 chassis for hose work. In addition $165,000 will be expended in fire alarm and police telegraph systems.

Palo Alto, Cal.—A bond issue of $50,500 for the purpose of building an auxiliary pumping station, garbage destroyer, concrete water works building, an automobile fire engine and steam condenser and water cooling tower, has been voted.

San Francisco, Cal.—Contemplating the purchase of 6 auto chemical engines, 1,000 ft. 3½-in. fire hose for fireboats, and 3 auto trucks.

Denver, Colo.—One horse drawn steam fire engine and two auto fire trucks will be purchased. B. F. Owens.

Havana, Ga.—A fire alarm system is being extended to Ballantyne.

Murphysboro, Ill.—This city is contemplating the purchase of 40 gallon chemical engine. J. L. Schmidvall, mayor.

Mishawaka, Ind.—City will purchase an American La France auto combination chemical truck.

Lewiston, Me.—The purchase of an auto truck is contemplated.

Milford, Mass.—The city is contemplating the purchase of an automobile fire truck. Fire chief Crockett.

Palmer, Mass.—The city will buy an auto fire truck. W. H. Holbrook, Palmer, Mass.

South Farmingham, Mass.—The purchase of an auto chemical engine and an auto combination chemical wagon is contemplated.

Springfield, Mass.—The city is contemplating the purchase of auto apparatus.

Whately, Mass.—Contemplating the purchase of a fire engine.

Iron River, Mich.—The purchase of a combination hose and chemical wagon is contemplated. Chas. McFarland.

Pewamo, Mich.—The purchase of a chemical engine is contemplated.

Saginaw, Mich.—The city is contemplating auto fire engine. B. G. Appleby, secy. real estate board.

Springfield, Mo.—Contemplating the purchase of an auto combination chemical wagon.

Columbus, Neb.—The purchase of an auto is contemplated.

Hollis, N. H.—Contemplating the purchase of a chemical engine.

Hempstead, N. H.—Contemplating the purchase of a chemical engine.

Succasunna, N. J.—This city is contemplating the purchase of chemical engine. E. C. Harvey.

Delmar, N. Y.—The purchase of two chemical engineers is contemplated.

Port Chester, N. Y.—A $100,000 sewage disposal plant is contemplated. B. O. Frederick, pres. bd. of trus.

Tarboro, N. C.—The purchase of fire equipment is contemplated. M. W. Haynes.

Cincinnati, O.—Extension of fire limits will require purchase of two hose wagns and one auto chemical wagon enginee. Archibald.

Lorain, O.—The city is contemplating the purchase of auto apparatus.

Beggs, Okla.—City is considering the purchase of a gasoline fire engine and 500 ft. of hose.

Medford, Ore.—City is contemplating purchase of automobile equipment. F. H. Cowles.

Easton, Pa.—City is contemplating the purchase of motor chemical and hose wagon, scaling ladder, 500 feet of hose, etc. Chief Ricker.

Lewiston, Pa.—Contemplating the purchase of fire hose and equipment.

Millersville, Pa.—City will purchase automobile engine and other apparatus. H. T. Short, chairman council committee.

Washington, Pa.—The purchase of an auto hose truck is contemplated. Patrick Curran, fire chief.

Camden, S. C.—The purchase of an auto hose wagon is contemplated.

St. Albans, Vt.—The city is contemplating the purchase of a combination chemical truck, auto propelled.

Moundsville, W. Va.—The city is contemplating the purchase of an auto fire truck.

CONTRACTS TO BE LET.

Washington, D. C.—May 1, 2 p. m. Furnishing motor car for fire department as noted in Bulletin of April 15. Property clerk, 320 District Bldg.

Princeton, N. J.—July 5. Furnishing automobile propelled pumping engine. E. M. Updike.

CONTRACTS AWARDED.

Los Angeles, Cal.—The city has purchased 5 pieces of auto propelled apparatus from the Seagrave Co., Columbus, O.

Lexington, Ky.—Furnishing triple combination hose wagon, to Knox Automobile Co., Springfield, Mass., $8,600; combination chemical and hose wagon, to Knox Automobile Co., $5,600.

Long Branch, N. J.—Furnishing auto propelled fire engine, to American La France Fire Engien Co., Elmira, N. Y., $4,700.

Mt. Vernon, N. Y.—Furnishing two heavy fire engine tenders, to Combination Ladder Co., Mt. Vernon, N. Y., $1,800.

Chester, Pa.—Installing fire alarm system, to Gamewell Co., 19 Barclay St., New York, N. Y., $14,860.

Nashville, Tenn.—Installing fire alarm system, to Gamewell Fire Alarm Telegraph Co., New York; hose wagon, to Seagrave Co., Columbus, O.

Tacoma, Wash.—Contract for furnishing 25 electric fire alarm boxes to Gamewell Fire Alarm Telegraph Co., 19 Barclay St., New York City.

TOO LATE FOR CLASSIFICATION

Concord, Cal.—A bond issue of $29,000 for sewer construction has been voted. Sloan & Robson. San Francisco, Cal., engrs.

Charles City, Ia.—Contract for Fifth ave. sewer to R. C. de la Hunt, Cedar Rapids, Ia.